Cruise Report
S-250 Oceans & Climate

Scientific Data Collected Aboard
SSV *Robert C. Seamans*

San Diego, CA, USA – Papeete, Tahiti, French Polynesia
5 November 2013 – 20 December 2013

Sea Education Association
Woods Hole, Massachusetts

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To obtain unpublished data, contact the Chief Scientist or SEA data archivist:

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Suzette Shipp	Atlanta Technical College

Introduction

This cruise report provides a summary of scientific activities aboard the SSV *Robert C. Seamans* during cruise S-250 (5 November – 20 December 2013). This was the sea component of an oceanography-focused ‘Oceans & Climate’ SEA Semester program, during which undergraduate science majors examined how the global ocean functions in the climate system. Research was conducted throughout our 4000nm transect from San Diego to Tahiti, as we sailed from California, traversing the California Current and the southern part of the North Pacific Subtropical Gyre, across the equatorial region with its complex and dynamic current systems, and into the northern part of the South Pacific Subtropical Gyre. We made two port stops during the cruise, both in French Polynesia—a first stop at Nuku Hiva, the largest of the Marquesas Islands, and a second stop at Fakarava Atoll, the second largest of the Tuamotu atolls. Both stops provided opportunities for the students to explore the islands and interact with the local communities, while also having dedicated time to work on their scientific research projects.

While onboard, the students served as full, working members of the scientific team and sailing crew, deploying oceanographic sampling equipment, managing shipboard operations, and conducting independent project research related to climate change. They completed two academic courses (*Oceanographic Field Methods* and *Directed Oceanographic Research*), earning upper-division credit at Boston University for subsequent transfer to their home institutions. Extensive oceanographic sampling was conducted for both the student research projects (Table 1) and the ongoing SEA research program. Students examined the diverse physical, chemical, biological, and environmental oceanographic characteristics in accordance with their written proposals prepared onshore before sailing, and presented their results in a final poster session and in papers. The resulting student papers are available upon request from SEA.

The brief summary of data contained in this report is not intended to represent final data interpretation and should not be excerpted or cited without written permission from SEA.

Audrey W. Meyer
Chief Scientist, S-250

Table 1. Student research projects, S-250.

Title	Student Investigator(s)
An Exploration of the Relationship Between Barrier Layers and Tropical Cyclones in the Eastern Pacific	Maya Becker Elina Berglund
Examining Characteristics of Barrier Layers and Their Formation in the Subtropical Pacific	Ellen Bechtel Mikasa Quaife
Relationships of Food Availability to Thecosomatous Pteropod Abundance, Diversity, and Distribution in the Southeast Pacific	Robin Alexis Byron Elly Fireside-Ostergaard
Effect of Low pH on the Growth Rate of Phytoplankton in the Eastern Pacific Ocean	Alice Chapman Michelle Muth
Comparing Carbon Flux in the Equatorial Pacific	Maddy Gold Kit Pavlekovsky
A Comparison of Nitrite and Nitrate Profiles Through Varying Current Systems in the Eastern Pacific	Kalina Grabb Robert Hollis
Phytoplankton Abundance Response to Trace Metal Incubation in the Central Pacific	Katherine Hays
A Comparison of Current Measurement Instrumentation: ADCP versus Geostrophic Equations	Robert Alexander Kovell James Crawford
The Impacts of Ocean Acidification on the Geographic Distribution, Abundance, Species Composition and Species Diversity of Ocean Thecosome Pteropods in the Southeast Pacific	Camille Pagniello
Phytoplankton Size Distribution in the Eastern Pacific as a Function of Latitude, Nitrate, pH, Alkalinity, and Temperature	Caitlin Russell
Controlling Factors of AOU in the South Pacific	Suzette Shipp

Data Description

This section provides a record of data collected aboard the SSV *Robert C. Seamans* cruise S-250 (US State Department Cruise F2013-067) from San Diego, California to Papeete, Tahiti, French Polynesia (Figure 1).

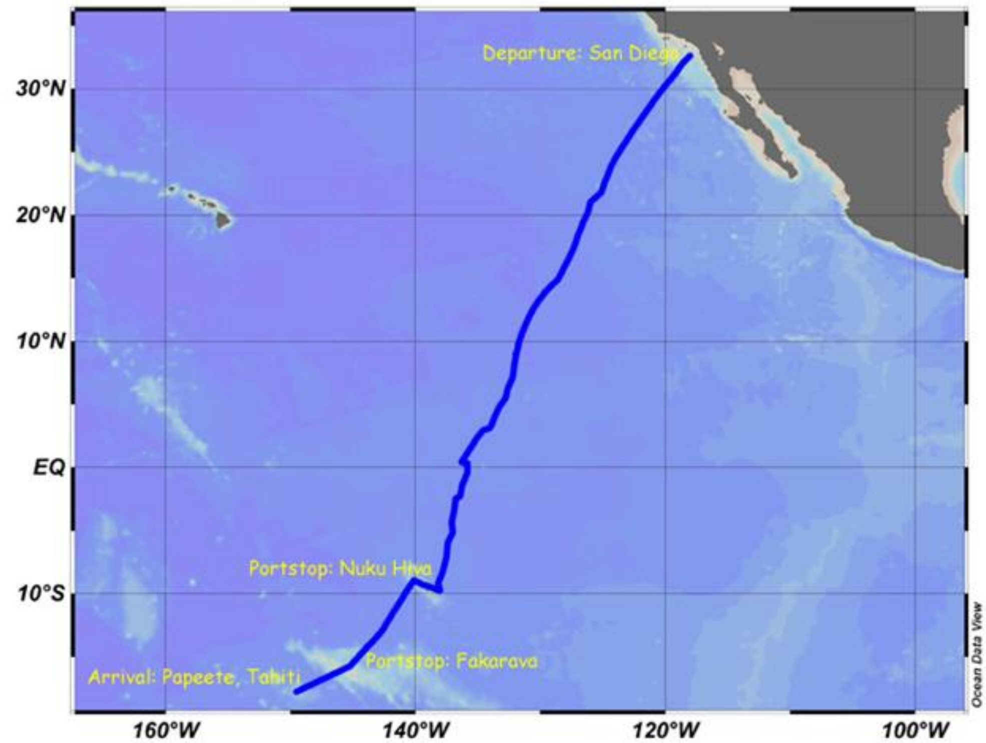


Figure 1. Hourly positions along the S-250 cruise track.

During the 7-week voyage, we collected oceanographic samples and deployed scientific gear at 65 discrete stations (see Table 2, including explanatory footnote). Chemical analyses were made of 60 surface water samples, all of which occurred coincident with hydrocast and biological sampling (neuston net and meter net) stations (Table 3). Additionally, we continuously sampled water depth and sub-bottom profiles (CHIRP system), upper ocean currents (ADCP, Figures 2 and 3), and sea surface temperature, salinity, colored dissolved organic matter (CDOM), and transmittance (seawater flow-through system, Figure 4 – temperature, salinity). Discrete CTD measurements of vertical temperature and salinity profiles are presented in Figure 5. Additional instrumentation on the hydrocast stations allowed profiling of dissolved oxygen, chlorophyll-*a* fluorescence, transmittance, photosynthetically active radiation (PAR) and CDOM (Figure 6). Summaries of sea surface and water column chemical and biological properties are found in Tables 4-7. Information about ARGO floats deployed during the cruise is given in Table 8. Results of sediment analyses are given in Table 9. Voluminous CTD, CHIRP, ADCP and flow-through data are not fully presented here. All unpublished data can be made available by arrangement with the SEA data archivist (contact information, p. 2).

Table 2. Oceanographic sampling stations. **X** indicates type of station. (NT = Neuston Tow, MN = Meter Net, 2MN = 2-Meter Net, PN = Phytoplankton Net, CTD = Free CTD, HC = Hydrocast with 12 Niskin bottles, CTD and optical instrumentation, SS = Surface Station, SG = Shipek Grab, ARGO = NOAA Pacific Marine Environmental Laboratory ARGO float. See additional footnotes at bottom of table, continued on next two pages.

Station[1]	Date	Time	Latitude	Longitude	General Locale[2]	NT	MN	2MN	PN	CTD	HC	SS[3]	SG	OTHER
S250-001	7-Nov-13	2219	32°34.4'N	118°05.8'W	San Clemente Basin	**X**					**X**	#13		
S250-002	8-Nov-13	1005	31°55.6'N	118°44.7'W	Offshore California	**X**					**X**	#13		
S250-003	8-Nov-13	2101	31°06.0'N	119°18.7'W	California Current	**X**	**X**		**X**		**X**	#13		
S250-004	9-Nov-13	1007	29°57.9'N	120°13.5'W	California Current	**X**					**X**	#13		
S250-005	9-Nov-13	2227	29°04.1'N	120°53.6'W	California Current	**X**					**X**	#13		
S250-006	10-Nov-13	0731	28°47.8'N	121°03.5'W	California Current	**X**					**X**	#13		
S250-007	10-Nov-13	2125	27°56.3'N	121°49.7'W	CA Current/NPSG	**X**	**X**		**X**		**X**	#13		
S250-008	11-Nov-13	1026	26°40.8'N	124°44.1'W	CA Current/NPSG	**X**					**X**	#13		
S250-009	11-Nov-13	2205	25°30.0'N	123°27.7'W	NPSG	**X**					**X**	#13		
S250-010	12-Nov-13	1004	24°11.0'N	124°11.8'W	NPSG	**X**					**X**	#13		
S250-011	12-Nov-13	2124	23°22.6'N	124°29.5'W	NPSG	**X**	**X**		**X**		**X**	#13		
S250-012	13-Nov-13	1011	22°32.1'N	124°54.4'W	NPSG	**X**					**X**	#13		
S250-013	13-Nov-13	2217	21°43.7'N	125°10.0'W	NPSG	**X**					**X**	#13		
S250-014	14-Nov-13	1025	21°04.0'N	126°02.4'W	NPSG	**X**			**X**		**X**	#13		
S250-015	14-Nov-13	2111	20°16.7'N	126°13.1'W	NPSG	**X**	**X**		**X**		**X**	#13		
S250-016	15-Nov-13	1053	19°23.1'N	126°37.1'W	NPSG	**X**					**X**	#13		
S250-017	15-Nov-13	2210	18°26.6'N	127°01.5'W	NPSG	**X**			**X**		**X**	#13		
S250-018	16-Nov-13	1011	17°44.8'N	127°19.8'W	NPSG	**X**					**X**	#13		
S250-019	16-Nov-13	2219	16°52.2'N	127°32.5'W	NPSG/NEC	**X**					**X**	#13		
S250-020	17-Nov-13	2208	14°53.3'N	128°37.9'W	NEC	**X**			**X**		**X**	#13		
S250-021	18-Nov-13	1050	14°23.8'N	129°03.9'W	NEC	**X**					**X**	#13		
S250-022	18-Nov-13	2121	13°54.5'N	129°44.6'W	NEC	**X**	**X**				**X**	#13		

Table 2, continued.

Station[1]	Date	Time	Latitude	Longitude	General Locale[2]	NT	MN	2MN	PN	CTD	HC	SS[3]	SG	OTHER
S250-023	19-Nov-13	1016	13°08.5'N	130°12.6'W	NEC	**X**			**X**		**X**	#13		
S250-024	19-Nov-13	2234	12°21.7'N	130°37.8'W	NEC	**X**			**X**		**X**	#13		
S250-025	20-Nov-13	1003	11°28.6'N	131°04.3'W	NEC	**X**					**X**	#13		
S250-026	20-Nov-13	2214	10°31.6'N	131°27.7'W	NEC	**X**					**X**	#13		
S250-027	21-Nov-13	1020	9°45.9'N	131°51.3'W	NEC	**X**					**X**	#13		
S250-028	21-Nov-13	2221	9°00.2'N	132°05.6'W	NECC	**X**	**X**		**X**		**X**	#13		
S250-029	22-Nov-13	1013	8°02.2'N	132°07.9'W	NECC	**X**					**X**	#13		
S250-030	22-Nov-13	2140	7°16.1'N	132°13.2'W	NECC	**X**					**X**	#13		
S250-031	23-Nov-13	1016	6°13.1'N	132°35.7'W	NECC	**X**					**X**	#13		
S250-032	23-Nov-13	2108	5°34.7'N	132°44.1'W	NECC	**X**			**X**		**XX**	#13		
S250-033	24-Nov-13	1038	4°42.8'N	133°22.8'W	NECC	**X**					**X**	#13		
S250-034	24-Nov-13	2237	3°05.5'N	134°03.1'W	NECC	**X**	**X**				**X**	#13		
S250-035	25-Nov-13	1019	2°57.9'N	134°33.4'W	SEC	**X**			**X**		**X**	#13		
S250-036	25-Nov-13	2214	2°27.0'N	134°59.2'W	SEC	**X**			**X**		**X**	#13		
S250-037	26-Nov-13	0719	1°52.6'N	135°31.1'W	SEC									**ARGO**
S250-038	26-Nov-13	2233	0°26.1'N	136°20.2'W	SEC	**X**					**X**	#13		
S250-039	27-Nov-13	0522	0°00.1'S	136°08.7'W	Equator									**ARGO**
S250-040	27-Nov-13	1037	0°22.6'S	135°51.9'W	SEC	**X**					**X**	#13		
S250-041	27-Nov-13	2239	1°16.1'S	136°16.5'W	SEC	**X**					**X**	#13		
S250-042	28-Nov-13	1023	2°13.0'S	136°29.3'W	SEC	**X**					**X**	#13		
S250-043	28-Nov-13	2026	2°28.1'S	136°39.4'W	SEC	**X**			**X**		**X**	#13		
S250-044	29-Nov-13	1007	3°30.6'S	136°53.1'W	SEC	**X**					**X**	#13		
S250-045	29-Nov-13	2128	4°22.6'S	137°03.0'W	SEC	**X**	**X**				**X**	#13		
S250-046	30-Nov-13	1034	5°07.7'S	137°03.9'W	SEC	**X**					**X**	#13		
S250-047	30-Nov-13	2216	5°51.9'S	137°22.4'W	SEC	**X**			**X**		**X**	#13		

Table 2, continued.

Station[1]	Date	Time	Latitude	Longitude	General Locale[2]	NT	MN	2MN	PN	CTD	HC	SS[3]	SG	OTHER
S250-048	1-Dec-13	1004	6°53.4'S	137°30.2'W	SEC	**X**					**X**	#13		
S250-049	1-Dec-13	2227	8°04.7'S	137°48.3'W	SEC	**X**					**X**	#13		
S250-050	2-Dec-13	1026	9°07.7'S	138°10.2'W	SEC	**X**			**X**		**X**	#13		
S250-051	2-Dec-13	2129	9°37.2'S	138°08.3'W	SPSG	**X**	**X**		**X**		**XX**	#13		
S250-052	3-Dec-13	2230	9°12.2'S	139°32.9'W	SPSG	**X**					**X**	#13		
S250-053	4-Dec-13	0921	8°56.9'S	140°03.3'W	Nuku Hiva								**XX**	
S250-056	8-Dec-13	2223	9°56.8'S	140°46.4'W	SPSG	**X**					**X**	#13		
S250-057	9-Dec-13	1022	10°35.7'S	141°13.2'W	SPSG						**X**	#13		
S250-058	9-Dec-13	2013	11°11.5'S	141°35.1'W	SPSG	**X**		**X**			**X**	#13		
S250-059	10-Dec-13	1026	12°11.8'S	142°13.5'W	SPSG	**X**					**X**	#13		
S250-060	10-Dec-13	2124	12°46.6'S	142°39.9'W	SPSG	**X**					**X**	#13		
S250-061	11-Dec-13	1004	13°35.2'S	143°16.9'W	SPSG	**X**					**X**	#13		
S250-062	11-Dec-13	2212	14°06.5'S	143°54.7'W	SPSG	**X**			**X**		**X**	#13		
S250-063	12-Dec-13	2233	15°37.0'S	145°16.1'W	SPSG	**X**					**X**	#13		
S250-066	13-Dec-13	1200	16°03.3'S	145°37.6'W	Fakarava									**MISC**
S250-067	16-Dec-13	2225	16°33.3'S	146°27.4'W	SPSG	**X**								
S250-068	17-Dec-13	0923	16°35.7'S	147°03.4'W	SPSG					**X**				
S250-069	17-Dec-13	2235	16°49.6'S	148°06.2'W	SPSG	**X**								

1 Stations S250-054, S250-055, S250-064, and S250-065 are not listed here because no scientific data were collected. They identify the locations at which small boat deployments were made in support of island portcalls.

2 General locales are categorized by traditional oceanic biomes. General locale designators: NPSG = North Pacific Subtropical Gyre; NEC = North Equatorial Current; ITCZ = Intertropical Convergence Zone; NECC = North Equatorial Countercurrent; SEC = South Equatorial Current; EUC = Equatorial Undercurrent; SECC = South Equatorial Countercurrent; SPSG = South Pacific Subtropical Gyre.

3 Surface station data for hydrocast stations came from water samples collected in lab from flow-through system while carousel was being deployed. These samples are designated as 'Bottle #13'. Blank indicates no surface water sample collected.

Table 3. Surface sampling station data. See footnotes at bottom of table, continued on next two pages.

Station[1,2]	Date	Time (Local)	Latitude	Longitude	Temp (°C)	Salinity (PSU)	Chl-a[3] (ug/l)	PO_4[3] (µM)	Nitrate[3] (µM)	Nitrite[3] (µM)
S250-001-HC #13	7-Nov-13	2219	32°34.4’ N	118°05.8’ W	18.4	33.71	0.14		0.41	-0.05
S250-002-HC #13	8-Nov-13	1005	31°55.6’ N	118°44.7’ W	18.1	33.60	0.08	0.41	-0.02	
S250-003-HC #13	8-Nov-13	2108	31°06.0’ N	119°18.7’ W	18.5	33.69		0.27	0.11	0.02
S250-004-HC #13	9-Nov-13	1007	29°57.9’ N	120°13.5’ W	18.2	33.47	0.08	0.27	0.07	
S250-005-HC #13	9-Nov-13	2227	29°04.1’ N	120°53.6’ W	20.0	33.81	0.07	0.27	0.73	-0.07
S250-006-HC #13	10-Nov-13	1019	28°41.0’ N	121°06.3’ W	19.8	33.83	0.12	0.23	0.08	
S250-007-HC #13	10-Nov-13	2125	27°56.3’ N	121°49.7’ W	19.7	33.68	0.04	0.27	0.04	-0.01
S250-008-HC #13	11-Nov-13	1026	26°40.8’ N	122°44.1’ W	20.3	33.89	0.03	0.23	-0.09	
S250-009-HC #13	11-Nov-13	2205	25°30.0’ N	123°27.7’ W	20.7	34.02	0.05	0.27	0.03	-0.03
S250-010-HC #13	12-Nov-13	1004	24°11.0’ N	124°11.8’ W	21.6	34.50	0.03	0.11		
S250-011-HC #13	12-Nov-13	2124	23°22.6’ N	124°29.5’ W	21.5	34.39	0.05	0.19	0.01	-0.12
S250-012-HC #13	13-Nov-13	1011	22°32.1’ N	124°54.4’ W	21.8	34.59	0.04	0.30	-0.52	
S250-013-HC #13	13-Nov-13	2217	21°43.7’ N	125°10.0’ W	22.0	34.64	0.04	0.22	-0.02	0.02
S250-014-HC #13	14-Nov-13	1025	21°04.0’ N	126°02.4’ W	22.8	34.83	0.05	0.26	-0.11	
S250-015-HC #13	14-Nov-13	2121	20°16.6’ N	126°13.2’ W	22.8	34.85	0.04	0.19	0.03	-0.15
S250-016-HC #13	15-Nov-13	1053	19°23.1’ N	126°37.1’ W	24.2	34.70	0.05	0.28		
S250-017-HC #13	15-Nov-13	2210	18°26.6’ N	127°01.5’ W	25.0	34.64	0.06	0.30	0.00	-0.11
S250-018-HC #13	16-Nov-13	1011	17°44.8’ N	127°19.8’ W	25.2	34.62	0.06	0.32	-0.10	
S250-019-HC #13	16-Nov-13	2219	16°52.2’ N	127°32.5’ W	25.5	34.58	0.04	0.36	0.10	-0.11
S250-020-HC #13	17-Nov-13	2208	14°53.3’ N	128°37.9’ W	26.2	34.51	0.05	0.33	0.13	-0.16
S250-021-HC #13	18-Nov-13	1050	14°23.8’ N	129°03.9’ W	26.8	34.31	0.01	0.34	-0.01	
S250-022-HC #13	18-Nov-13	2121	13°54.5’ N	129°44.6’ W	27.0	34.17	0.05	0.25	0.06	-0.12
S250-023-HC #13	19-Nov-13	1021	13°08.4’ N	130°12.8’ W	26.9	34.01	0.08		-0.03	

Table 3, continued.

Station[1,2]	**Date**	**Time**	**Latitude**	**Longitude**	**Temp (°C)**	**Salinity (PSU)**	**Chl-a[3] (ug/l)**	**PO_4[3] (µM)**	**Nitrate[3] (µM)**	**Nitrite[3] (µM)**
S250-024-HC #13	19-Nov-13	2234	12°21.7' N	130°37.8' W	26.9	33.90	0.07	0.23	0.11	-0.15
S250-025-HC #13	20-Nov-13	1003	11°28.6' N	131°04.3' W	27.0	33.86	0.12	0.18	0.17	
S250-026-HC #13	20-Nov-13	2219	10°31.6' N	131°27.7' W	26.9	33.93	0.06	0.15	0.14	-0.12
S250-027-HC #13	21-Nov-13	1020	9°45.9' N	131°51.3' W	26.9	34.06	0.10	0.10	-0.04	
S250-028-HC #13	21-Nov-13	2221	9°00.2' N	132°05.6' W	27.4	33.97	0.08	0.16	0.12	-0.16
S250-029-HC #13	22-Nov-13	1013	8°02.2' N	132°07.9' W	28.0	34.63	0.09	0.19	-0.07	
S250-030-HC #13	22-Nov-13	2140	7°16.1' N	132°13.2' W	28.1	34.59	0.09	0.14	0.12	-0.16
S250-031-HC #13	23-Nov-13	1016	6°13.1' N	132°35.7' W	27.6	33.97		0.18	0.51	
S250-032-HC #13A	23-Nov-13	2118	5°34.7' N	132°44.1' W	28.0	34.74				
S250-032-HC #13B	23-Nov-13	2245	5°35.1' N	132°43.7' W	28.0	34.74	0.09	0.17	0.65	-0.10
S250-033-HC #13	24-Nov-13	1045	4°42.8' N	133°22.8' W	27.9	35.05	0.13	0.34	1.79	
S250-034-HC #13	24-Nov-13	2237	3°05.5' N	134°03.1' W	27.6	35.10	0.10	0.26	2.20	-0.05
S250-035-HC #13	25-Nov-13	1019	2°57.9' N	134°33.4' W	26.5	34.79	0.06	0.36	3.54	
S250-036-HC #13	25-Nov-13	2216	2°27.0' N	134°59.2' W	26.4	34.82	0.12	0.36	3.53	0.04
S250-038-HC #13	26-Nov-13	2228	0°26.1' N	136°20.2' W	25.7	34.94	0.13	0.51	4.35	0.36
S250-040-HC #13	27-Nov-13	1037	0°22.6' S	135°51.9' W	25.3	35.07	0.11	0.53	5.50	
S250-041-HC #13	27-Nov-13	2239	1°16.1' S	136°16.5' W	25.5	35.14	0.07	0.15	6.142	0.50
S250-042-HC #13	28-Nov-13	1023	2°13.0' S	136°29.3' W	25.8	35.18	0.14	0.52	6.22	
S250-043-HC #13	28-Nov-13	2048	2°28.1' S	136°39.6' W	26.0	35.34	0.15	0.65	4.65	0.69
S250-044-HC #13	29-Nov-13	1007	3°30.6' S	136°53.1' W	26.9	35.50	0.10	0.65	5.36	
S250-045-HC #13	29-Nov-13	2128	4°22.6' S	137°03.0' W	27.0	35.50	0.07	0.60	5.66	0.19
S250-046-HC #13	30-Nov-13	1034	5°07.7' S	137°03.9' W	27.0	35.48	0.08	0.56	4.56	
S250-047-HC #13	30-Nov-13	2216	5°51.9' S	137°22.4' W	26.9	35.49	0.07	0.55	5.57	0.16

Table 3, continued.

Station[1,2]	Date	Time	Latitude	Longitude	Temp (°C)	Salinity (PSU)	Chl-*a*[3] (ug/l)	PO_4[3] (µM)	Nitrate[3] (µM)	Nitrite[3] (µM)
S250-048-HC #13	1-Dec-13	1004	6°53.4' S	137°30.2' W	27.3	35.60	0.13		5.66	
S250-049-HC #13	1-Dec-13	2227	8°04.7' S	137°48.3' W	27.6	35.67	0.07	0.40	4.76	0.15
S250-050-HC #13	2-Dec-13	1026	9°07.7' S	138°10.2' W	27.9	35.73	0.13	0.46	4.01	
S250-051-HC #13A	2-Dec-13	2239	9°39.2' S	138°08.2' W	28.0	35.78		0.48	3.499	0.13
S250-051-HC #13B	2-Dec-13	2340	9°40.5' S	138°08.8' W	28.0	35.79				
S250-052-HC #13	3-Dec-13	2230	9°12.2' S	139°32.9' W	27.2	36.80		0.43	1.41	0.24
S250-056-HC #13	8-Dec-13	2223	9°56.8' S	140°46.4' W	28.5	35.67				
S250-057-HC #13	9-Dec-13	1022	10°35.7' S	141°13.2' W	28.7	35.66				
S250-058-HC #13	9-Dec-13	2013	11°11.5' S	141°35.1' W	28.5	35.60				
S250-059-HC #13	10-Dec-13	1026	12°11.8' S	142°13.5' W	28.5	35.61				
S250-060-HC #13	10-Dec-13	2124	12°46.6' S	142°39.9' W	28.5	35.66				
S250-061-HC #13	11-Dec-13	1004	13°35.2' S	143°16.9' W	28.4	35.65				
S250-062-HC #13	11-Dec-13	2215	14°06.5' S	143°54.7' W	28.3	35.50				
S250-063-HC #13	12-Dec-13	2233	15°37.0' S	145°16.1' W	28.1	35.75				

[1] Surface station data for hydrocast stations came from water samples collected in lab from flow-through system while carousel was being deployed. These samples are designated as 'Bottle #13' (e.g. S250-001-HC #13).

[2] Two hydrocasts were collected at each of Stations S250-032 and S250-051. The second cast at S250-032 was collected because most of the bottles did not fire during the first cast; the second cast at S250-051 was collected to acquire water samples from additional water depths. Surface station water samples were designated #13A and #13B to distinguish whether they came from the first or the second cast, respectively.

[3] No chlorophyll-*a*, phosphate, nitrate, or nitrite analyses were made of Bottle #13 samples collected during the final portion of the cruise track from Fakarava to Tahiti (Stations S250-056-HC through S250-063-HC).

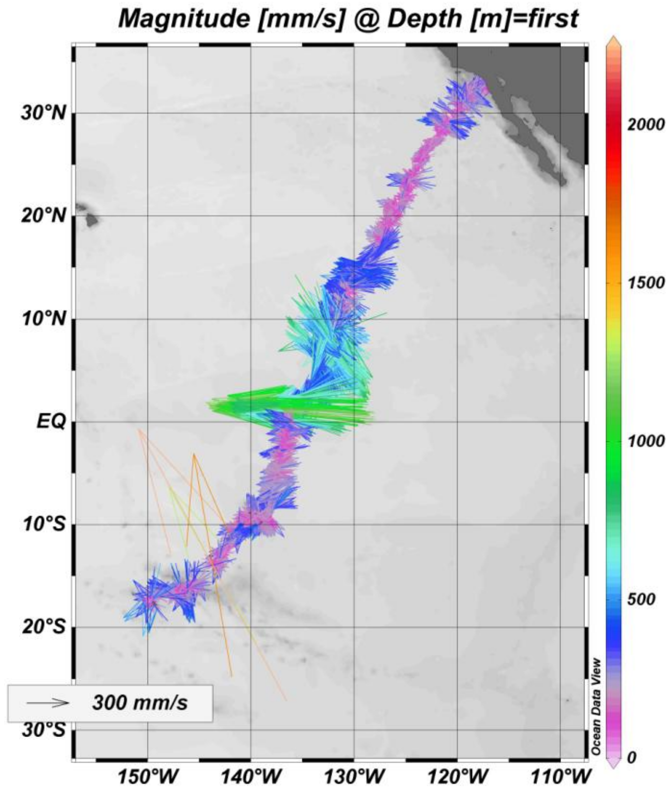


Figure 2. Surface current velocity (direction and magnitude) measured with the ADCP across equatorial current systems traversed during SEA Cruise S-250.

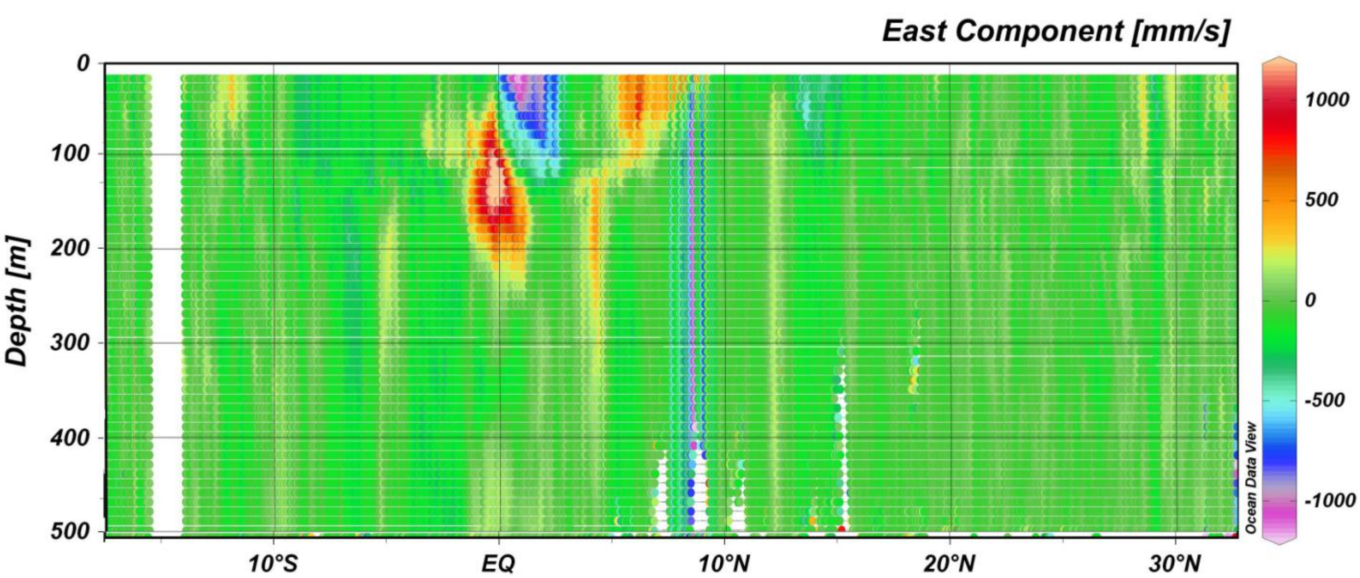
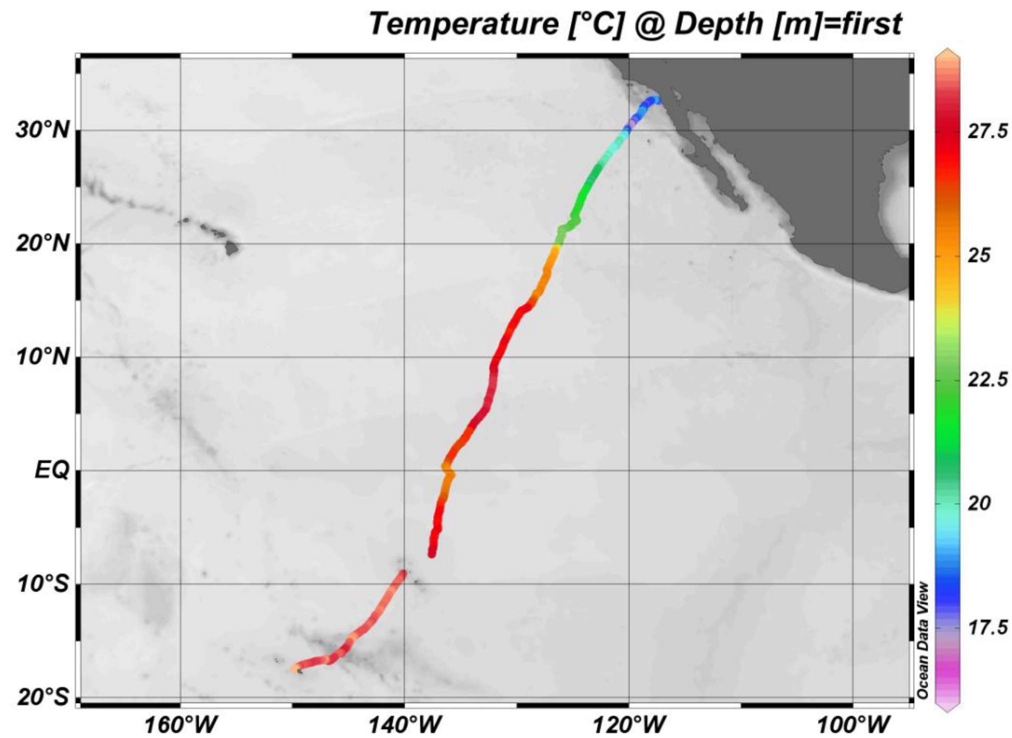


Figure 3. East-west velocity component of currents, in mm/sec, measured along S-250 cruise track. Positive values represent current flow in eastward direction; negative values represent current flow in westward direction. Note that 500 mm/s is ~1.0 knot.



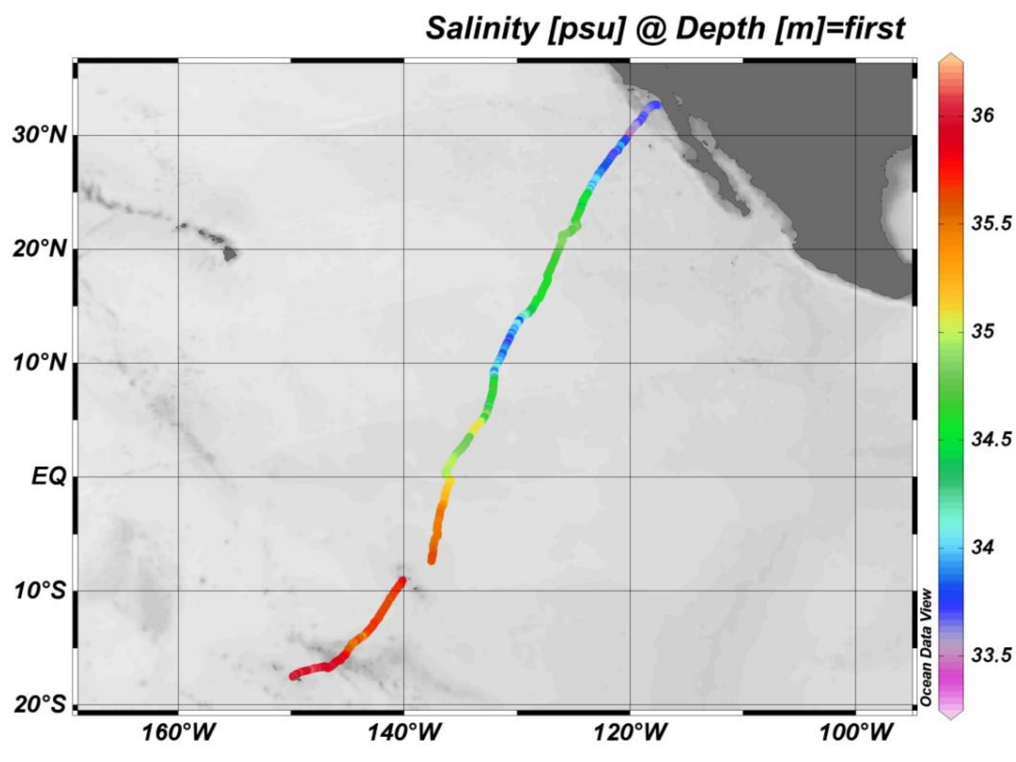


Figure 4. Hourly surface temperature (top figure) and surface salinity measurement (bottom figure) from the continuous flow-through SeaBird Thermosalinography (S/N 0022) data logger collected during Cruise S-250.

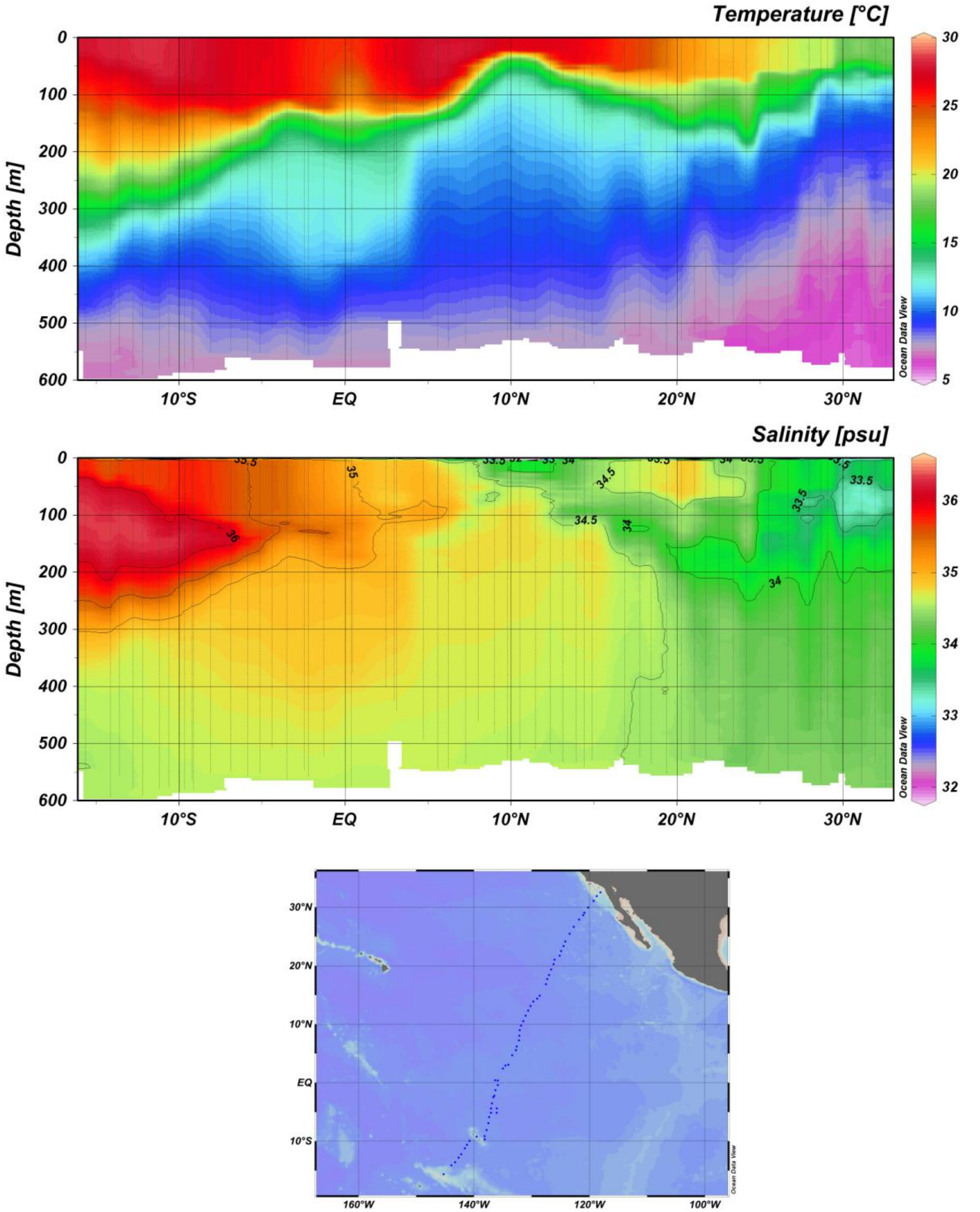


Figure 5. Temperature (top) and salinity (middle) cross sections created from CTD data collected along the entire S-250 cruise track. Blue dots on map (bottom) indicate locations of stations included in the section. Data gathered during hydrocast stations utilizing a SeaBird 19PlusV2 CTD (S/N 4043).

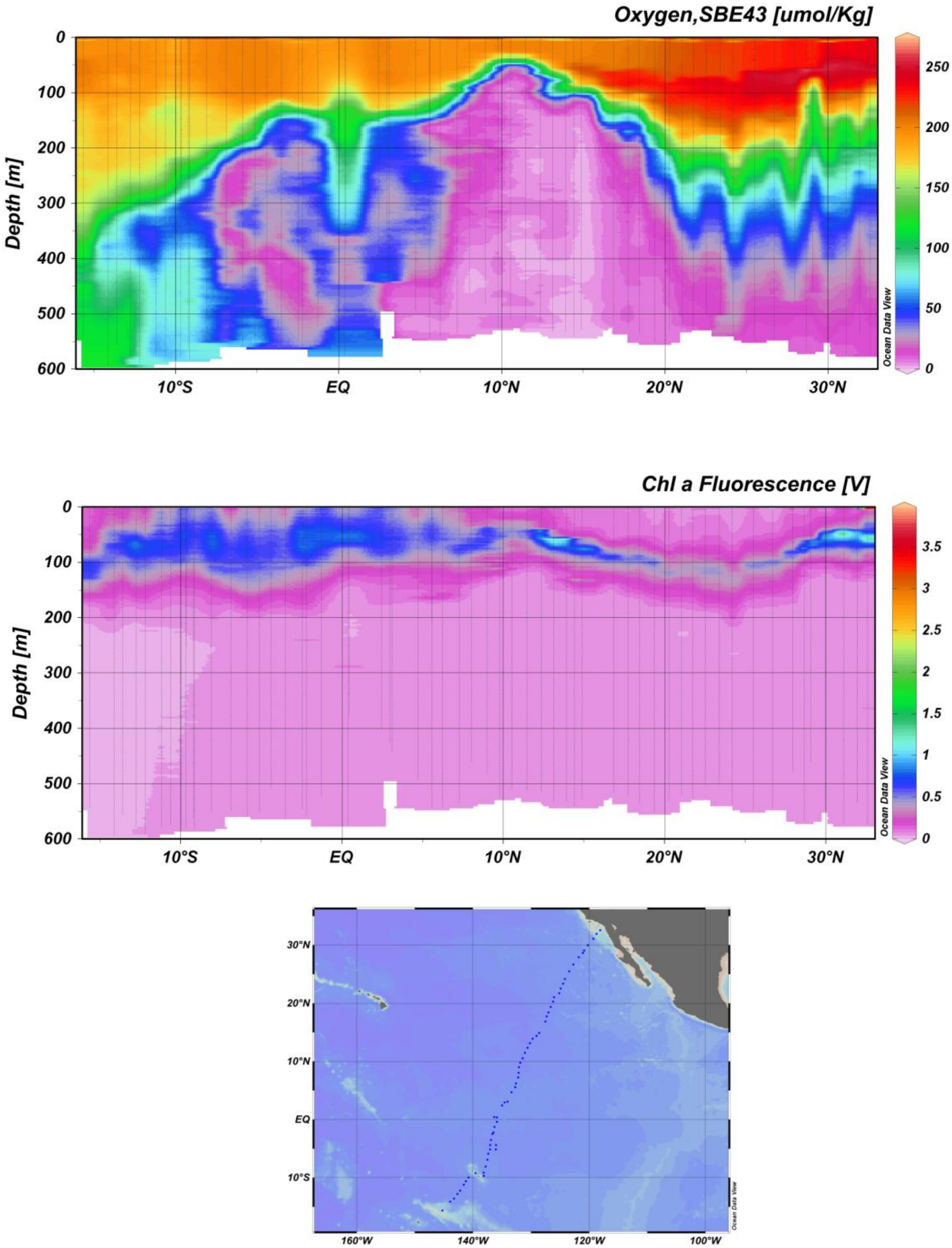


Figure 6. Oxygen (top) and raw fluorescence (middle) cross sections. The oxygen and fluorescence sensors are mounted on the carousel during hydrocast/CTD deployments during Cruise S-250. Blue dots on map (bottom) indicate locations of stations included in the section. Data gathered during hydrocast stations utilizing Seapoint Chlorophyll fluorometer (S/N SCF3149) and SeaBird Dissolved Oxygen sensor (Model 43; S/N 1120).

Table 4. S-250 Hydrocast (HC) bottle data. Station locations and general locales are given in Table 2. Associated surface sample data (designated ‘Bottle #13’) are given in Table 3. Analyses conducted as given in footnote at bottom of this table (see page 26).

Station	Bottle #	Depth (m)	Temp (°C)	Salinity (PSU)	Dissolved Oxygen (mL/L)	Chl a (ug/l)	PO_4 (μM)	Nitrate (μM)	Nitrite (μM)	pH	Total Alkalinity (Meq/L)	Carbonate Alkalinity (umol/kg)
S250-001-HC	2	396.1	6.8	34.23	0.58		3.51	15.00	0.02	7.513		
S250-001-HC	4	197.7	8.8	34.04	2.02	0.01		15.00	0.00	7.661		
S250-001-HC	6	98.2	10.8	33.55	3.76	0.06				7.725		
S250-001-HC	8	48.9	15.5	33.61	5.65	0.54				8.007	2.66	2592.94
S250-001-HC	10	23.8	17.9	33.70	5.43	0.17						
S250-001-HC	12	5.6	18.0	33.70	5.41					8.057	2.49	2430.03
S250-002-HC	2	396.0	7.2	34.31	0.44						2.37	2311.99
S250-002-HC	6	198.3	8.9	33.89	2.93						2.37	2308.44
S250-002-HC	8	99.2	11.6	33.42	4.70						2.29	2235.84
S250-002-HC	10	49.4	15.8	33.40	5.69					5.884	2.42	2359.80
S250-002-HC	12	4.9	17.8	33.59	5.39					7.977	2.43	2370.42
S250-003-HC	1	297.4	7.3	34.11	1.42		2.34	13.48	0.03	7.474		
S250-003-HC	2	248.5	8.1	34.10	1.79			15.57	0.01			
S250-003-HC	3	223.3	8.2	34.04	2.06			14.60	0.03			
S250-003-HC	4	198.7	8.8	34.03	2.19	0.00		16.70	0.07			
S250-003-HC	5	174.0	9.0	33.97	2.47			17.24	0.03			
S250-003-HC	6	149.6	9.4	33.88	2.68			16.87	0.10	7.633		
S250-003-HC	7	124.3	9.8	33.66	3.58	0.01	1.47	10.15				
S250-003-HC	8	60.0	13.0	33.22	5.52			3.27	0.59			
S250-003-HC	9	50.0	13.7	33.22	5.67	0.30		1.86	0.40	7.945	2.35	2292.51
S250-003-HC	10	39.8	15.8	33.44	5.75			0.19	0.08			
S250-003-HC	11	10.3	18.3	33.68	5.34			0.23	0.04			
S250-003-HC	12	5.7	18.3	33.68	5.35			-0.03		8.033	2.54	2480.21
S250-004-HC	2	396.3	6.5	34.15	0.86					7.488		
S250-004-HC	6	198.0	8.8	33.94	2.85					7.642		
S250-004-HC	8	98.6	11.5	33.30	5.11					7.851		
S250-004-HC	10	48.2	15.2	33.32	5.82					8.011	1.21	1180.49
S250-004-HC	11	5.5	17.8	33.47	5.43					8.017	2.23	2173.87
S250-005-HC	2	397.1	7.0	34.30	0.45062		2.79	19.85	0.00	7.442		
S250-005-HC	4	197.6	8.8	34.14	1.90372	0.00		11.96	0.01	7.564		
S250-005-HC	5	99.4	10.5	33.86	2.4965	0.06				7.647		
S250-005-HC	8	49.4	19.6	33.86	5.15281	0.13				8.032	2.27	2216.37
S250-005-HC	10	24.5	19.7	33.87	5.16657	0.08						
S250-005-HC	11	5.3	19.7	33.87	5.17266					8.035	2.98	2911.67
S250-006-HC	2	396.0	6.7	34.19	0.80					7.469		
S250-006-HC	6	198.0	8.9	34.00	2.77					7.620		
S250-006-HC	8	98.4	11.2	33.56	4.17					7.744		
S250-006-HC	10	49.3	19.2	33.79	5.26					7.966		
S250-007-HC	2	396.8	6.7	34.16	0.98		1.99	25.00	-0.02	7.499		
S250-007-HC	4	149.4	12.1	33.58	4.67	0.05		4.08	0.04	7.859	2.55	2483.16
S250-007-HC	6	98.7	14.8	33.53	5.62	0.13	0.38			7.968		
S250-007-HC	8	49.6	19.5	33.78	5.22	0.06				8.031	1.97	1925.97
S250-007-HC	12	5.6	19.3	33.67	5.27					8.029	2.29	2234.07
S250-008-HC	2	396.3	7.6	34.30	0.62					7.469		

Table 4, continued.

Station	Bottle #	Depth (m)	Temp (°C)	Salinity (PSU)	Dissolved Oxygen (mL/L)	Chl a (ug/l)	PO_4 (µM)	Nitrate (µM)	Nitrite (µM)	pH	Total Alkalinity (Meq/L)	Carbonate Alkalinity (umol/kg)
S250-008-HC	6	198.5	10.2	33.88	3.22					7.656		
S250-008-HC	8	98.1	15.9	33.70	5.52					7.934		
S250-008-HC	10	49.1	19.9	33.92	5.17					7.939	2.18	2130.78
S250-008-HC	12	4.6	20.0	33.90	5.19					8.024	2.15	2093.60
S250-009-HC	2	397.1	7.7	34.29	0.70		2.36	18.15	-0.14	7.425		
S250-009-HC	4	197.6	10.2	33.83	3.43	0.01		8.32	0.01	7.753		
S250-009-HC	6	98.4	16.0	33.71	5.54	0.13				7.947		
S250-009-HC	8	48.9	20.2	34.00	5.14	0.04				7.982		
S250-009-HC	9	25.3	20.2	34.00	5.15	0.03						
S250-009-HC	12	5.3	20.4	34.02	5.15					7.960		
S250-010-HC	2	396.0	7.9	34.25	1.03					7.477		
S250-010-HC	6	197.5	12.0	33.74	4.08					7.955		
S250-010-HC	8	98.9	18.8	34.31	5.33					8.008		
S250-010-HC	10	47.8	21.1	34.49	5.06					7.972	1.56	1524.60
S250-010-HC	11	5.4	21.3	34.51	5.05			-0.15		8.008	2.14	2088.87
S250-011-HC	1	298.0	9.7	34.38	0.93		0.25	0.18	0.06	8.326		
S250-011-HC	5	198.5	10.9	33.88	3.47	0.02						
S250-011-HC	6	174.2	12.1	33.78	3.90					8.193	1.09	1059.49
S250-011-HC	7	150.2	13.8	33.85	4.74			0.04	-0.03			
S250-011-HC	8	124.3	16.4	34.12	5.06			0.04	-0.01			
S250-011-HC	9	99.6	17.9	34.13	5.22	0.17				8.301		
S250-011-HC	10	50.5	21.6	34.62	4.99	0.07				8.355	2.40	2343.86
S250-011-HC	11	9.8	21.3	34.39	5.04			0.04	-0.09			
S250-011-HC	12	5.2	21.3	34.39	5.05					8.347	2.38	2318.48
S250-012-HC	1	354.7	8.7	34.37	0.65					7.733		
S250-012-HC	6	181.2	11.8	33.83	3.50					7.665		
S250-012-HC	8	93.2	18.3	34.14	5.32					7.994		
S250-012-HC	10	50.3	21.6	34.62	4.99					8.073	2.34	2283.65
S250-012-HC	12	4.7	21.2	34.39	5.04					8.142	3.24	3159.58
S250-013-HC	1	397.7	7.5	34.31	0.65		2.54	17.96	0.01	7.413		
S250-013-HC	2	323.3	8.4	34.23	1.42			16.18	-0.04			
S250-013-HC	3	298.4	8.9	34.22	1.76			15.22	0.04			
S250-013-HC	4	272.9	9.7	34.27	1.70			14.43	-0.03			
S250-013-HC	5	248.7	10.3	34.19	2.13			11.14	-0.01			
S250-013-HC	6	223.6	10.7	34.06	2.64			17.77	0.02			
S250-013-HC	7	198.9	11.0	33.89	3.51	0.02		12.97	0.00	7.717		
S250-013-HC	8	173.9	11.9	33.82	4.05			9.26	0.26			
S250-013-HC	9	149.6	13.7	33.85	4.52	0.08		2.11	0.09			
S250-013-HC	10	99.4	18.3	34.16	5.32	0.22		0.03	0.03	7.994		
S250-013-HC	11	49.3	21.7	34.64	4.98	0.07		0.10	0.01	8.057	2.34	2280.11
S250-013-HC	12	5.5	21.7	34.64	5.00			-0.01	0.02	8.088	2.27	2217.55
S250-014-HC	2	396.9	7.7	34.36	0.51					7.444		
S250-014-HC	6	197.5	11.2	33.85	3.70					7.768		
S250-014-HC	8	97.8	18.8	34.44	5.21					8.019		
S250-014-HC	10	48.9	22.3	34.82	4.91					8.043	2.45388	2394.02987
S250-014-HC	12	6.3	22.5	34.83	4.89					8.075	2.65	2584.09
S250-015-HC	2	397.1	8.7	34.48	0.20		2.38	0.00	-0.10	7.388		

Table 4, continued.

Station	Bottle #	Depth (m)	Temp (°C)	Salinity (PSU)	Dissolved Oxygen (mL/L)	Chl a (ug/l)	PO_4 (μM)	Nitrate (μM)	Nitrite (μM)	pH	Total Alkalinity (Meq/L)	Carbonate Alkalinity (umol/kg)
S250-015-HC	4	149.6	16.4	34.33	4.59	0.11				7.856	2.27	2213.42
S250-015-HC	6	100.3	19.2	34.49	5.20	0.17	0.25			7.993		
S250-015-HC	8	47.8	22.5	34.85	4.90	0.05				8.041	2.36	2304.31
S250-015-HC	10	11.2	22.5	34.85	4.90			0.00	-0.11			
S250-015-HC	12	3.8	22.5	34.85	4.90					8.053	2.13	2078.25
S250-016-HC	2	396.5	8.8	34.51	0.17					7.437		
S250-016-HC	6	199.2	11.9	34.30	1.25					7.490		
S250-016-HC	8	99.4	18.9	34.30	4.93					7.698		
S250-016-HC	10	49.2	23.5	34.79	4.84					8.078	2.17	2113.07
S250-016-HC	12	4.1	23.9	34.69	4.77					8.421	2.25	2192.17
S250-017-HC	1	397.5	8.7	34.49	0.20		2.51	0.00	0.00	7.477		
S250-017-HC	4	108.0	16.9	34.07	3.74			0.00	0.20	7.931	2.59	2525.65
S250-017-HC	7	87.6	20.0	34.33	4.94			0.24	-0.03	8.061	2.41	2353.30
S250-017-HC	8	50.5	24.5	34.72	4.77					7.664	2.53	2468.40
S250-017-HC	11	8.6	24.7	34.64	4.70			0.03	-0.06			
S250-017-HC	12	5.3	24.7	34.64	4.70					8.181	2.60	2538.64
S250-018-HC	2	396.7	8.3	34.49	0.22					7.429		
S250-018-HC	6	197.5	11.4	34.57	0.54					7.488		
S250-018-HC	8	98.6	18.4	34.19	4.80					7.957		
S250-018-HC	10	50.0	24.9	34.61	4.67					8.116	2.48	2420.00
S250-018-HC	12	4.7	24.9	34.61	4.69					8.119	2.74	2670.85
S250-019-HC	1	397.6	8.5	34.54	0.13		2.71	22.17	-0.26	7.431		
S250-019-HC	2	298.5	9.6	34.57	0.11			15.99	-0.13			
S250-019-HC	3	273.8	10.0	34.57	0.15			16.19	-0.08			
S250-019-HC	4	248.7	10.3	34.57	0.19			12.73	-0.08			
S250-019-HC	5	223.8	10.7	34.60	0.17			13.90	-0.09			
S250-019-HC	6	198.9	11.3	34.60	0.24	0.00		15.34	-0.10	7.505		
S250-019-HC	7	175.3	12.1	34.59	0.32			9.04	-0.08			
S250-019-HC	8	149.8	11.8	34.19	2.18	0.01		17.44	-0.04			
S250-019-HC	9	124.1	13.4	34.01	2.91			10.23	0.06			
S250-019-HC	10	99.8	16.7	34.14	4.29	0.16		3.87	0.45	7.984		
S250-019-HC	11	50.6	25.2	34.58	4.66	0.05		0.06	-0.12	8.216	2.26	2203.97
S250-019-HC	12	5.6	25.2	34.58	4.68			0.06	-0.13	8.199	2.38	2322.61
S250-020-HC	2	396.7	9.2	34.61	0.02		2.53	17.90	-0.11	7.421		
S250-020-HC	4	149.5	12.8	34.74	0.02	0.06		9.41	1.20	7.548		
S250-020-HC	6	98.9	16.0	34.24	2.35	0.19				7.757	2.28	2226.99
S250-020-HC	8	48.9	23.4	34.66	5.00	0.13				8.111		
S250-020-HC	10	8.6	25.9	34.51	4.62			0.12	-0.16			
S250-020-HC	12	5.8	25.9	34.51	4.61					8.168	2.29	2231.12
S250-021-HC	2	395.4	9.1	34.62	0.02					7.411		
S250-021-HC	5	198.7	11.5	34.74	0.02	0.04				7.454		
S250-021-HC	7	98.6	15.0	34.64	0.03	0.14				7.481		
S250-021-HC	8	74.5	17.5	34.35	4.45	0.30						
S250-021-HC	10	49.8	21.0	34.39	5.11	0.18				8.010	2.006785	1957.83951
S250-021-HC	12	4.9	26.5	34.32	4.62					8.069	2.21188	2157.93225
S250-022-HC	2	396.9	9.0	34.60	0.07		1.78	18.42	-0.10	7.912		
S250-022-HC	5	148.9	11.9	34.70	0.06			16.18	-0.13	7.902	2.25	2190.99

Table 4, continued.

Station	Bottle #	Depth (m)	Temp (°C)	Salinity (PSU)	Dissolved Oxygen (mL/L)	Chl a (ug/l)	PO_4 (µM)	Nitrate (µM)	Nitrite (µM)	pH	Total Alkalinity (Meq/L)	Carbonate Alkalinity (umol/kg)
S250-022-HC	6	124.6	12.0	34.50	0.56	0.02						
S250-022-HC	7	99.1	12.5	34.17	2.19	0.06				8.110		
S250-022-HC	8	74.5	15.9	34.50	1.54	0.16						
S250-022-HC	10	48.1	24.7	34.39	4.48	0.27				8.427	2.22	2165.61
S250-022-HC	12	4.5	26.7	34.18	4.59					8.543	1.91	1863.99
S250-023-HC	2	465.3	8.2	34.57	0.03					7.903		
S250-023-HC	5	249.5	10.4	34.64	0.06	0.01				7.920		
S250-023-HC	6	169.3	11.5	34.70	0.09	0.02						
S250-023-HC	7	140.4	12.1	34.68	0.05	0.03						
S250-023-HC	8	113.3	12.1	34.38	1.04	0.12				7.940		
S250-023-HC	10	87.9	13.0	34.11	2.43	0.16				8.163	2.09	2039.29
S250-023-HC	12	8.4	26.7	34.17	4.58					8.549	2.23	2171.51
S250-024-HC	2	396.1	8.9	34.59	0.02		1.83	18.79	-0.13	7.456		
S250-024-HC	4	148.8	11.6	34.70	0.01	0.02		13.19	0.03	7.520		
S250-024-HC	6	99.3	12.4	34.54	0.47	0.03				7.558		
S250-024-HC	8	49.5	19.8	34.51	2.48	0.26				7.862	2.28	2222.86
S250-024-HC	10	9.6	26.6	33.90	4.58			0.11	-0.15			
S250-024-HC	12	6.0	26.5	33.91	4.59					8.162	2.38	2320.84
S250-025-HC	2	396.8	9.1	34.63	0.03					7.462		
S250-025-HC	5	198.9	10.9	34.73	0.05	0.01				7.502		
S250-025-HC	7	99.6	12.3	34.78	0.03	0.05				7.532		
S250-025-HC	8	73.8	13.1	34.71	0.04	0.12						
S250-025-HC	10	50.1	15.0	34.37	1.32	0.21				7.715	2.65	2585.27
S250-025-HC	12	4.2	26.7	33.86	4.58					8.135	2.42	2362.75
S250-026-HC	2	342.0	9.6	34.66	0.03		2.50	17.28	-0.15	7.441		
S250-026-HC	5	92.0	12.7	34.76	0.02	0.01		16.95	-0.13	7.528		
S250-026-HC	7	34.2	19.4	34.39	3.37	0.03				7.513		
S250-026-HC	8	17.4	26.7	33.86	4.56	0.10						
S250-026-HC	10	10.1	26.7	33.86	4.57	0.23				7.613	2.20	2150.85
S250-026-HC	12	1.6	26.7	32.40	5.73					8.127	1.40	1367.60
S250-027-HC	2	396.4	8.9	34.64	0.20					7.502		
S250-027-HC	5	200.0	10.4	34.72	0.25	0.01				7.529		
S250-027-HC	7	98.3	11.6	34.76	0.08	0.04				7.513		
S250-027-HC	8	74.4	12.3	34.72	0.10	0.17						
S250-027-HC	10	49.0	13.9	34.45	1.05	0.22				7.580	2.17	2114.25
S250-027-HC	12	5.0	26.5	34.05	4.59					8.120	2.12	2068.22
S250-028-HC	1	396.8	9.0	34.65	0.03		1.88	18.95	0.03	7.404		
S250-028-HC	2	99.6	12.1	34.74	0.13	0.11				7.501		
S250-028-HC	3	65.1	14.3	34.33	2.06	0.12		7.00	0.28	7.670	1.84	1791.39
S250-028-HC	6	47.8	17.4	34.50	3.95	0.11				7.859	2.03	1976.73
S250-028-HC	7	40.1	18.7	34.58	4.20					7.931	1.76	1719.38
S250-028-HC	9	9.6	27.1	33.99	4.52			0.11	-0.14			
S250-028-HC	12	6.2	27.2	33.99	4.53					8.129	2.28	2226.40
S250-029-HC	2	397.6	9.1	34.65	0.04					7.483		
S250-029-HC	5	198.5	10.8	34.73	0.47					7.550		
S250-029-HC	6	150.6	11.4	34.74	0.26	0.01						
S250-029-HC	7	99.7	12.5	34.67	0.23	0.07				7.531		
S250-029-HC	8	73.9	15.7	34.42	3.21	0.16						

Table 4, continued.

Station	Bottle #	Depth (m)	Temp (°C)	Salinity (PSU)	Dissolved Oxygen (mL/L)	Chl a (ug/l)	PO_4 (µM)	Nitrate (µM)	Nitrite (µM)	pH	Total Alkalinity (Meq/L)	Carbonate Alkalinity (umol/kg)
S250-029-HC	10	50.5	21.7	34.85	4.92	0.16				8.030	2.28	2228.76
S250-029-HC	12	4.9	27.7	34.63	4.51					8.140	2.38	2323.20
S250-030-HC	1	397.7	9.2	34.66	0.11		1.65	18.67	-0.11	7.363		
S250-030-HC	2	297.3	10.2	34.70	0.11			13.99	0.08			
S250-030-HC	3	272.9	10.4	34.71	0.31			13.77	-0.10			
S250-030-HC	4	248.7	10.6	34.73	0.43			14.18	-0.08			
S250-030-HC	5	223.4	10.8	34.74	0.15			18.89	-0.02			
S250-030-HC	6	198.4	11.1	34.74	0.22	0.08			-0.05	7.966		
S250-030-HC	7	173.5	11.4	34.74	0.15			19.33	-0.01			
S250-030-HC	8	148.8	11.8	34.75	0.08	0.03		17.68	0.02			
S250-030-HC	9	124.2	13.0	34.59	0.49			13.67	0.35			
S250-030-HC	10	100.2	16.6	34.54	2.32	0.14		-0.30	0.53	7.782		
S250-030-HC	11	49.1	27.8	34.61	4.47	0.11		0.31	0.02	8.109	2.39	2327.33
S250-030-HC	12	5.0	27.8	34.59	4.50			0.25	-0.14	8.177	2.50	2435.94
S250-031-HC	2	396.2	9.0	34.66	0.42					7.521		
S250-031-HC	5	199.3	11.0	34.73	0.55	0.04				7.580		
S250-031-HC	7	99.5	22.2	34.97	3.12	0.14				7.953		
S250-031-HC	8	74.3	25.6	35.08	3.96	0.13						
S250-031-HC	10	48.6	27.7	34.80	4.43	0.15				8.074	2.31	2250.01
S250-031-HC	12	4.7	27.4	34.08	4.54	0.11				8.091	2.26	2206.92
S250-032-HCA	1	397.9	9.0	34.66	0.84		1.86	15.75	-0.09	7.520		
S250-032-HCB	3	198.2	11.1	34.73	0.75	0.01						
S250-032-HCB	4	147.9	13.4	34.62	0.85	0.06				7.585		
S250-032-HCB	5	124.4	20.6	34.81	2.82	0.09		9.47	-0.05	7.896		
S250-032-HCB	8	48.5	27.8	34.92	4.49	0.19				8.125	2.36	2298.41
S250-032-HCB	10	9.4	27.7	34.78	4.52			0.56	-0.09			
S250-032-HCB	11	5.5	27.7	34.78	4.51					8.135	2.31	2252.96
S250-033-HC	2	396.5	9.3	34.67	0.36					7.514		
S250-033-HC	5	198.6	11.2	34.65	1.02	0.01				7.605		
S250-033-HC	7	98.7	26.8	35.08	4.20	0.13				8.091		
S250-033-HC	10	48.5	27.5	35.05	4.49	0.14				8.161	2.38	2324.38
S250-033-HC	11	4.8	27.5	35.05	4.51					8.166	2.26	2201.02
S250-034-HC	2	395.3	9.9	34.72	1.28		1.49	16.39	-0.08	7.682		
S250-034-HC	4	199.4	13.3	34.93	1.28	0.01		13.90	-0.01	7.646		
S250-034-HC	7	100.4	25.1	35.01	3.96	0.09				8.009		
S250-034-HC	8	74.6	26.1	34.78	4.58	0.13						
S250-034-HC	10	49.3	27.0	35.01	4.50	0.09				8.100	1.53	1489.78
S250-034-HC	11	6.2	27.3	35.05	4.51					8.083	1.55	1511.62
S250-035-HC	2	396.9	10.2	34.72	0.82					7.532		
S250-035-HC	5	199.2	13.4	34.94	0.97	0.01				7.633		
S250-035-HC	7	99.5	25.4	35.03	4.37	0.18				8.040		
S250-035-HC	8	74.7	26.1	34.80	4.60	0.14						
S250-035-HC	10	48.1	26.2	34.79	4.63	0.12				8.150	2.70	2635.44
S250-035-HC	12	5.4	26.2	34.79	4.63					8.120	0.71	690.59
S250-036-HC	1	396.3	10.3	34.73	0.92		2.12	23.23	-0.04	7.594		
S250-036-HC	3	199.9	13.4	34.93	0.96	0.01						

Table 4, continued.

Station	Bottle #	Depth (m)	Temp (°C)	Salinity (PSU)	Dissolved Oxygen (mL/L)	Chl a (ug/l)	PO_4 (μM)	Nitrate (μM)	Nitrite (μM)	pH	Total Alkalinity (Meq/L)	Carbonate Alkalinity (umol/kg)
S250-036-HC	4	149.1	18.8	34.96	2.55	0.02				7.834		
S250-036-HC	6	99.5	25.2	34.92	4.38	0.10		4.04	0.21	8.047		
S250-036-HC	8	48.3	26.1	34.82	4.60	0.12				8.110	2.58	2521.52
S250-036-HC	10	8.8	26.1	34.82	4.63			3.22	0.04			
S250-036-HC	12	4.6	26.1	34.82	4.62					8.057	1.13	1101.99
S250-038-HC	2	370.9	10.8	34.79	0.37		2.17	23.31	0.18	7.478		
S250-038-HC	5	199.2	14.1	34.99	2.75	0.00		11.29	0.01	7.784		
S250-038-HC	7	100.1	22.6	34.92	3.66	0.11		7.72	1.21	7.934		
S250-038-HC	8	75.4	23.2	34.88	4.09	0.21						
S250-038-HC	10	48.8	24.7	34.92	4.38	0.15				8.137		
S250-038-HC	12	6.3	25.4	34.94	4.52					8.096	2.35	2297.23
S250-040-HC	2	397.1	10.1	34.75	0.53					7.567		
S250-040-HC	5	199.2	13.2	34.96	2.42	0.00				7.772		
S250-040-HC	7	100.2	24.1	35.49	3.34	0.09				7.989		
S250-040-HC	8	74.9	24.3	35.26	3.71	0.13						
S250-040-HC	10	50.3	24.7	35.13	4.09	0.17				8.037	2.36	2305.49
S250-040-HC	12	4.7	25.1	35.07	4.34					8.077	2.26	2205.15
S250-041-HC	1	397.5	10.7	34.79	1.28		2.01	21.17	-0.05	7.590		
S250-041-HC	2	298.3	11.7	34.84	0.97			21.61	0.00			
S250-041-HC	3	248.8	12.2	34.88	0.68			19.86	-0.01			
S250-041-HC	4	199.5	13.2	34.96	0.51	0.02		21.36	-0.05	7.579		
S250-041-HC	5	179.6	14.3	35.07	1.35			15.49	-0.03			
S250-041-HC	6	159.1	16.3	35.28	1.61			13.63	-0.01			
S250-041-HC	7	139.1	18.5	35.49	2.06	0.05		11.27	0.39			
S250-041-HC	8	119.9	25.3	35.40	4.09			6.86	1.03			
S250-041-HC	9	99.5	25.2	35.30	4.17	0.10	0.46	6.22	0.52	8.033		
S250-041-HC	10	74.3	25.2	35.20	4.24	0.18		6.43	0.54			
S250-041-HC	11	50.0	25.2	35.16	4.33	0.17		6.11	0.48	8.051	2.76	2689.74
S250-041-HC	12	5.4	25.2	35.14	4.39			6.10	0.51	8.059	2.35	2290.74
S250-042-HC	3	397.6	11.0	34.81	0.70					7.530		
S250-042-HC	4	396.6	11.0	34.81	0.71							
S250-042-HC	5	199.2	12.8	34.93	0.56	0.01				7.585		
S250-042-HC	7	99.2	25.5	35.32	4.37	0.18				8.045		
S250-042-HC	8	74.2	25.5	35.27	4.45	0.29						
S250-042-HC	10	48.4	25.4	35.20	4.48	0.17				8.051	2.31	2255.32
S250-042-HC	12	4.1	25.5	35.18	4.54					8.032	2.70	2636.03
S250-043-HC	1	397.9	10.9	34.81	0.31		2.30	22.89	0.27	7.505		
S250-043-HC	3	198.8	12.8	34.92	0.32	0.01				7.576		
S250-043-HC	4	149.8	15.0	35.16	0.69	0.11						
S250-043-HC	5	99.3	25.6	35.36	4.30	0.14		5.72	0.65	8.003		
S250-043-HC	6	73.7	25.6	35.34	4.38	0.22						
S250-043-HC	8	50.2	25.6	35.34	4.42	0.19				8.043	2.36	2304.90
S250-043-HC	10	9.1	25.7	35.34	4.44			5.51	0.56			
S250-043-HC	11	5.6	25.7	35.34	4.46					8.039	2.64	2571.69
S250-044-HC	2	397.0	10.4	34.78	0.19					7.519		
S250-044-HC	4	199.5	12.7	34.92	1.35	0.01				7.655		
S250-044-HC	6	125.1	19.2	35.48	2.61	0.11						
S250-044-HC	7	99.5	26.2	35.47	4.48	0.13				8.057		

Table 4, continued.

Station	Bottle #	Depth (m)	Temp (°C)	Salinity (PSU)	Dissolved Oxygen (mL/L)	Chl a (ug/l)	PO_4 (µM)	Nitrate (µM)	Nitrite (µM)	pH	Total Alkalinity (Meq/L)	Carbonate Alkalinity (umol/kg)
S250-044-HC	8	74.3	26.5	35.49	4.56	0.11						
S250-044-HC	10	48.7	26.5	35.49	4.56	0.12				8.061	2.04	1990.30
S250-044-HC	12	4.5	26.6	35.50	4.58					8.045	2.09	2042.24
S250-045-HC	2	397.4	10.2	34.76	0.11		2.42	23.12	0.18	7.492		
S250-045-HC	4	199.1	12.9	34.93	0.23	0.01						
S250-045-HC	5	149.2	15.9	35.20	1.87			12.24	0.12	7.798	1.34	1309.16
S250-045-HC	6	124.7	23.1	35.66	3.88	0.15						
S250-045-HC	7	99.7	26.4	35.47	4.53	0.17				8.095		
S250-045-HC	8	74.4	26.6	35.49	4.57	0.11						
S250-045-HC	10	49.5	26.6	35.49	4.59	0.10		5.42	0.22	8.125	1.00	978.62
S250-045-HC	12	4.0	26.7	35.49	4.60					8.117	2.16	2110.71
S250-046-HC	2	397.2	9.9	34.74	0.81					7.510		
S250-046-HC	4	198.4	14.2	35.04	1.15	0.02				7.747		
S250-046-HC	6	124.4	26.0	35.50	4.48	0.12						
S250-046-HC	7	99.3	26.4	35.48	4.57	0.15				8.076		
S250-046-HC	8	74.7	26.6	35.48	4.62	0.13						
S250-046-HC	10	49.3	26.6	35.48	4.64	0.12				8.090	2.73	2660.82
S250-046-HC	12	4.7	26.7	35.48	4.63					8.137	2.33	2271.85
S250-047-HC	1	397.4	9.8	34.74	0.18		2.17	25.76	0.07	7.458		
S250-047-HC	3	199.0	14.9	35.09	1.24	0.02				7.672		
S250-047-HC	4	124.8	25.8	35.60	4.29	0.12						
S250-047-HC	5	99.5	26.5	35.51	4.55	0.13	0.50	4.81	0.21	8.049		
S250-047-HC	6	74.9	26.5	35.49	4.60	0.12						
S250-047-HC	8	48.4	26.6	35.49	4.62	0.09				8.071	2.24	2181.54
S250-047-HC	10	9.6	26.6	35.49	4.63			4.34	0.20			
S250-047-HC	11	5.9	26.6	35.49	4.64					8.049	2.25	2192.17
S250-048-HC	2	396.2	9.9	34.75	0.66					7.403		
S250-048-HC	4	198.6	16.5	35.28	2.61	0.01				7.758		
S250-048-HC	7	98.8	26.9	35.61	4.52	0.13				7.971		
S250-048-HC	8	73.9	26.9	35.61	4.54	0.13						
S250-048-HC	10	49.6	26.9	35.61	4.57	0.11				7.971	2.42	2363.93
S250-048-HC	12	5.0	27.0	35.61	4.58					8.008	2.64	2577.60
S250-049-HC	2	397.3	9.5	34.71	1.35		1.74	22.03	0.20	7.578		
S250-049-HC	4	199.1	18.4	35.50	3.17	0.03						
S250-049-HC	5	148.9	22.8	36.17	3.83			6.54	2.44	7.999		
S250-049-HC	6	125.3	25.5	35.99	3.98	0.20						
S250-049-HC	7	99.7	27.2	35.69	4.48	0.13				8.093		
S250-049-HC	8	74.9	27.3	35.70	4.54	0.15						
S250-049-HC	10	47.3	27.3	35.69	4.55	0.16		4.24	0.18	8.099	2.28	2227.58
S250-049-HC	12	6.5	27.3	35.68	4.57					8.076	2.41	2352.12
S250-050-HC	1	397.4	9.4	34.71	1.69					7.555		
S250-050-HC	4	199.0	19.3	35.60	3.54	0.04				7.934		
S250-050-HC	6	124.0	25.8	36.13	3.95	0.16				8.116		
S250-050-HC	10	48.9	27.5	35.73	4.54	0.09				8.198	2.38	2320.25
S250-050-HC	12	5.2	27.6	35.73	4.54					8.145	2.31	2254.14
S250-051-HCA	1	218.2	17.1	35.32	3.30			10.68	0.19	7.570		
S250-051-HCA	2	209.2	18.7	35.58	3.84			6.35	0.12			

Table 4, continued.

Station	Bottle #	Depth (m)	Temp (°C)	Salinity (PSU)	Dissolved Oxygen (mL/L)	Chl a (ug/l)	PO_4 (µM)	Nitrate (µM)	Nitrite (µM)	pH	Total Alkalinity (Meq/L)	Carbonate Alkalinity (umol/kg)
S250-051-HCA	3	199.8	19.9	35.79	3.99			4.34	0.09			
S250-051-HCA	4	188.2	20.6	35.92	4.02			4.56	0.11			
S250-051-HCA	5	169.2	22.0	36.11	3.98			4.14	0.49			
S250-051-HCA	6	149.4	23.2	36.23	3.94			4.17	3.23		2.65	2587.04
S250-051-HCA	7	99.7	26.5	36.14	4.29		0.43	1.87	0.13			
S250-051-HCA	8	88.9	26.7	36.08	4.32			1.98	0.12			
S250-051-HCA	9	60.2	27.6	35.82	4.49			3.35	0.13			
S250-051-HCA	10	49.7	27.6	35.81	4.54			3.62	0.10		2.44	2383.41
S250-051-HCA	11	10.8	27.7	35.79	4.57			3.76	0.13			
S250-051-HCB	1	397.0	9.1	34.69	1.55		1.96	30.21	0.19			
S250-051-HCB	2	347.2	10.0	34.75	1.33			29.23	0.30			
S250-051-HCB	3	323.0	10.6	34.75	1.21			25.70	0.19	7.994		
S250-051-HCB	4	308.2	11.2	34.79	1.03			20.47	0.24			
S250-051-HCB	5	288.5	12.1	34.79	1.14			18.72	0.18			
S250-051-HCB	6	273.2	12.9	34.88	1.79			22.09	0.20	8.041		
S250-051-HCB	7	258.8	14.4	34.98	1.90			28.71	0.16			
S250-051-HCB	9	243.4	15.5	35.14	2.54			10.88	0.18			
S250-051-HCB	10	242.8	15.7	35.13	2.58					8.143		
S250-051-HCB	11	228.5	16.7	35.26	3.09			9.04	0.19			
S250-051-HCB	12	6.0	27.7	35.79	4.55					8.145	2.43	2370.42
S250-052-HC	2	396.2	8.8	34.67	2.03		2.09	23.67	0.39	7.596		
S250-052-HC	4	198.5	19.0	35.60	3.75			5.88	0.21	7.912		
S250-052-HC	7	99.1	26.8	35.96	3.88					8.083		
S250-052-HC	10	49.4	27.9	35.75	4.58			1.83	0.26	8.131	2.33	2273.03
S250-052-HC	12	3.7	27.9	35.76	4.61					8.158	2.49	2424.72
S250-056-HC	2	396.2	8.6	34.61	1.67					7.636		
S250-056-HC	4	198.9	20.0	35.62	2.71					7.982		
S250-056-HC	7	98.3	26.7	35.65	3.01					8.094		
S250-056-HC	10	47.6	28.1	35.70	3.50					8.132	1.25	1220.03
S250-056-HC	12	4.1	28.0	35.77	3.41					8.143	2.27	2218.73
S250-057-HC	2	397.1	9.1	34.65	1.90					7.581		
S250-057-HC	5	198.9	21.1	35.99	3.93					8.108		
S250-057-HC	8	99.8	27.2	35.89	4.02					8.063		
S250-057-HC	10	50.0	28.3	35.67	4.48					8.054	2.63	2562.25
S250-057-HC	12	4.2	28.4	35.68	4.51					8.048	1.61	1574.77
S250-058-HC	2	396.3	10.2	34.67	0.78					7.544		
S250-058-HC	4	198.7	21.0	35.98	3.94					8.021		
S250-058-HC	7	99.3	26.9	36.14	4.41					8.145		
S250-058-HC	10	49.1	28.3	35.62	4.48					8.161	2.52	2463.09
S250-058-HC	12	4.8	28.3	35.63	4.49					8.199	2.52	2457.19
S250-059-HC	2	395.7	9.6	34.65	1.33					7.569		
S250-059-HC	4	197.8	21.0	36.01	3.92					7.986		
S250-059-HC	8	99.9	26.3	36.25	4.36					8.118		
S250-059-HC	10	47.3	27.6	35.99	4.52					8.146	1.96	1912.39
S250-059-HC	12	4.6	28.3	35.63	4.51					8.160	2.45	2388.13
S250-060-HC	2	396.8	9.3	34.60	1.74					7.577		
S250-060-HC	4	197.9	20.6	35.92	3.92					7.993		

Table 4, continued.

Station	Bottle #	Depth (m)	Temp (°C)	Salinity (PSU)	Dissolved Oxygen (mL/L)	Chl a (ug/l)	PO_4 (µM)	Nitrate (µM)	Nitrite (µM)	pH	Total Alkalinity (Meq/L)	Carbonate Alkalinity (umol/kg)
S250-060-HC	7	99.5	25.8	36.29	4.30					8.139		
S250-060-HC	10	49.4	28.0	35.77	4.55					8.195	2.37	2313.17
S250-060-HC	12	4.3	28.2	35.68	4.47					8.173	2.28	2225.22
S250-061-HC	2	395.9	9.5	34.60	1.76					7.554		
S250-061-HC	4	198.7	20.2	35.85	3.95					7.970		
S250-061-HC	8	99.8	25.2	36.38	4.42					8.088		
S250-061-HC	10	49.8	27.1	36.06	4.52					8.119	2.24	2185.67
S250-061-HC	12	4.6	28.1	35.67	4.50					8.160	2.33	2270.67
S250-062-HC	2	394.9	11.0	34.68	1.58					7.591		
S250-062-HC	3	198.9	22.5	36.24	4.03					8.030		
S250-062-HC	5	99.1	25.9	36.26	4.44					8.128		
S250-062-HC	8	48.8	27.9	35.77	4.52					8.151	2.34	2283.06
S250-062-HC	12	4.6	28.0	35.52	4.48					8.125	2.19	2131.96
S250-063-HC	2	397.2	11.1	34.63	2.71					7.699		
S250-063-HC	4	198.2	20.6	35.90	3.86					8.011		
S250-063-HC	6	99.9	25.0	36.32	4.35					8.134		
S250-063-HC	10	48.1	26.6	36.21	4.65					8.177	2.64	2572.87
S250-063-HC	12	4.9	27.8	35.77	4.47					8.191	2.57	2504.41

Temperature and salinity data determined from a SeaBird 19Plus V2 CTD. Dissolved oxygen content from SeaBIrd Dissolved Oxygen sensor deployed with each hydrocast. Extracted chlorophyll-a samples were filtered through 0.45 µm filters and measured with a Turner Designs Model 10-AU fluorometer. Nutrients (PO4, NO3, and NO2) were assessed with colorometric spectrophotometry. Seawater pH was determined using m-cresol purple indicator dye and spectrophotometry. Alkalinity was measured by Gran titration. A blank space indicates that no sample was collected for that analysis.

Table 5. S-250 Neuston Net Tow (NT) data. Station locations and general locales are given in Table 2. Explanatory footnotes are given at bottom of table (see page 29). 100-count data of zooplankton samples are available from SEA.

Station	Tow Area (m^2)	Zoo. Biomass (ml)	Zoo. Density (ml/m^2)	Phyllo-soma (#)	Lepto-cephali (#)	Mycto-phids (#)	Cepha-lopods (#)	Other Nekton >2 cm (#)	Total Nekton (#)	Total Nekton (ml)	Plastic Pellets (#)	Plastic Pieces (#)	Tar Pieces (#)	Halo-bates (#)	Gelatinous Organisms >2cm (#)	Gelatinous Organisms >2cm (ml)
S250-001-NT	1485	233.0	0.1569	0	0	0	0	3	3	6.0	0	0	0	0	0	0.0
S250-002-NT	1488	55.0	0.0370	0	0	0	0	0	0	0.0	0	0	22	0	0	0.0
S250-003-NT	2400	38.0	0.0158	19	0	10	0	6	35	10.5	0	0	3	0	6	13.0
S250-004-NT	1705	172.0	0.1009	0	0	0	0	2	2	2.0	0	1	0	0	0	0.0
S250-005-NT	1110	25.0	0.0225	1	0	11	0	0	12	11.9	0	0	0	1	30	5.7
S250-006-NT	2248	19.0	0.0085	0	0	0	1	5	6	1.2	0	2	4	1	0	0.0
S250-007-NT	2611	15.0	0.0057	0	0	13	0	0	13	6.0	0	1	0	40	3	6.5
S250-008-NT	1567	127.0	0.0810	0	0	0	0	2	2	0.2	0	2	0	1	2	2.0
S250-009-NT	1568	75.5	0.0482	0	0	11	0	1	12	3.5	0	1	0	3	5	37.0
S250-010-NT	2027	3.5	0.0017	0	0	0	0	0	0	0.0	0	4	0	1	3	0.5
S250-011-NT	1717	8.0	0.0047	0	0	0	0	3	3	0.2	0	0	0	9	0	0.0
S250-012-NT	1661	2.5	0.0015	0	0	0	0	1	1	0.1	0	0	0	1	0	0.0
S250-013-NT	2240	5.8	0.0026	0	0	1	0	3	4	0.3	0	0	0	10	0	0.0
S250-014-NT	1743	0.8	0.0005	0	0	0	0	0	0	0.0	0	2	0	2	0	0.0
S250-015-NT	1778	15.0	0.0084	0	0	0	0	3	3	3.0	0	0	0	13	3	8.0
S250-016-NT	1806	4.3	0.0024	0	0	0	0	0	0	0.0	0	0	0	7	0	0.0
S250-017-NT	1185	7.0	0.0059	0	0	0	0	5	5	2.0	0	0	0	40	2	4.0
S250-018-NT	1892	5.0	0.0026	0	0	0	0	2	2	0.4	3	4	0	24	0	0.0
S250-019-NT	1668	33.0	0.0198	0	0	1	0	0	1	1.0	0	0	0	36	0	0.0
S250-020-NT	2208	83.0	0.0376	0	0	1	1	1	3	4.0	0	0	0	31	10	68.0

Table 5, continued.

Station	Tow Area (m^2)	Zoo. Biomass (ml)	Zoo. Density (ml/m^2)	Phyllo-soma (#)	Lepto-cephali (#)	Mycto-phids (#)	Cepha-lopods (#)	Other Nekton >2 cm (#)	Total Nekton (#)	Total Nekton (ml)	Plastic Pellets (#)	Plastic Pieces (#)	Tar Pieces (#)	Halo-bates (#)	Gelatinous Organisms >2cm (#)	Gelatinous Organisms >2cm (ml)
S250-021-NT	1932	4.2	0.0022	0	0	0	0	0	0	0.0	0	7	0	43	1	1.2
S250-022-NT	2231	25.5	0.0114	0	0	13	1	0	14	3.1	0	0	0	4	12	3.5
S250-023-NT	1705	32.0	0.0188	0	0	0	0	0	0	0.0	0	0	0	0	0	0.0
S250-024-NT	1630	41.0	0.0252	0	0	1	1	0	2	3.5	0	0	0	2	11	10.0
S250-025-NT	1587	13.5	0.0085	0	0	0	0	0	0	0.0	0	2	0	0	2	1.2
S250-026-NT	1489	99.2	0.0666	0	0	2	2	0	4	1.4	0	0	0	5	6	12.0
S250-027-NT	1161	5.0	0.0043	0	0	0	0	2	2	0.5	0	0	0	14	1	0.5
S250-028-NT	2991	57.0	0.0191	0	0	3	8	0	11	5.0	0	0	0	49	4	18.0
S250-029-NT	2431	15.0	0.0062	0	0	0	0	0	0	0.0	0	0	0	8	0	0.0
S250-030-NT	2047	34.0	0.0166	0	0	1	0	2	3	3.0	0	0	0	46	8	20.0
S250-031-NT	460	24.0	0.0522	0	0	0	0	0	0	0.0	0	0	0	8	16	6.0
S250-032-NT	1060	29.0	0.0273	0	0	0	0	0	0	0.0	0	0	0	0	2	3.0
S250-033-NT	2002	2.5	0.0012	0	0	0	0	0	0	0.0	0	0	0	0	0	0.0
S250-034-NT	2901	18.0	0.0062	0	0	9	0	0	9	1.2	0	0	0	0	6	4.5
S250-035-NT	2619	19.5	0.0074	0	0	0	0	0	0	0.0	0	0	0	0	0	0.0
S250-036-NT	2711	38.0	0.0140	0	0	6	0	0	6	3.0	0	0	0	0	8	2.0
S250-038-NT	2278	27.0	0.0119	0	0	40	0	0	40	10.0	0	0	0	0	21	18.5
S250-040-NT	1719	5.0	0.0029	0	0	0	0	0	0	0.0	0	0	0	0	0	0.0
S250-041-NT	1970	42.0	0.0213	0	0	30	0	3	33	7.5	0	0	0	0	33	21.0
S250-042-NT	1644	7.0	0.0043	0	0	0	0	0	0	0.0	0	0	0	0	0	0.0

Table 5, continued.

Station	Tow Area (m^2)	Zoo. Biomass (ml)	Zoo. Density (ml/m^2)	Phyllo-soma (#)	Lepto-cephali (#)	Mycto-phids (#)	Cepha-lopods (#)	Other Nekton >2 cm (#)	Total Nekton (#)	Total Nekton (ml)	Plastic Pellets (#)	Plastic Pieces (#)	Tar Pieces (#)	Halo-bates (#)	Gelatinous Organisms >2cm (#)	Gelatinous Organisms >2cm (ml)
S250-043-NT	1895	55.5	0.0293	0	0	51	0	0	51	7.0	0	0	0	1	35	17.0
S250-044-NT	1871	5.4	0.0029	0	0	0	0	0	0	0.0	0	0	0	0	0	0.0
S250-045-NT	1685	95.0	0.0564	0	0	13	0	1	14	5.7	0	0	0	1	21	25.0
S250-046-NT	1746	20.0	0.0115	0	0	0	0	2	2	3.0	0	0	0	0	7	10.0
S250-047-NT	2035	31.0	0.0152	0	0	0	0	4	4	1.0	0	0	0	0	14	10.0
S250-048-NT	1366	6.2	0.0045	0	0	0	0	0	0	0.0	0	0	0	0	7	3.5
S250-049-NT	1565	30.0	0.0192	0	0	3	0	1	4	1.2	0	0	0	0	15	26.8
S250-050-NT	2431	23.0	0.0095	0	0	0	0	3	3	0.6	0	1	0	0	0	0.0
S250-051-NT	1309	24.0	0.0183	0	0	4	0	24	28	7.7	0	0	0	3	10	6.8
S250-052-NT	1804	57.0	0.0316	18	0	43	1	80	142	76.3	0	0	0	3	9	25.0
S250-056-NT	1638	34.0	0.0208	0	0	5	0	0	0	0.0	0	0	0	0	2	2.0
S250-058-NT	1409	133.0	0.0944	1	0	4	0	0	5	1.6	0	0	0	2	7	3.3
S250-059-NT	2320	3.8	0.0016	0	0	0	0	2	2	0.8	0	0	0	21	1	0.4
S250-060-NT	1732	17.5	0.0101	1	0	9	0	3	13	1.4	0	2	0	4	3	1.5
S250-061-NT	2145	3.1	0.0014	0	0	1	0	0	1	0.1	1	1	0	32	0	0.0
S250-062-NT	1753	11.8	0.0067	0	0	3	0	26	29	3.3	0	0	0	16	9	7.3
S250-063-NT	2155	3.6	0.0017	0	0	8	0	5	13	4.3	0	1	0	46	2	1.0
S250-067-NT	1797	4.6	0.0026	0	0	1	0	0	1	0.1	0	0	0	3	1	6.0
S250-069-NT	2399	4.0	0.0017	0	0	0	0	0	0	0.0	0	0	0	7	1	0.2

[1] Tow area calculated using distance (meters) between successive minutes' GPS positions. Neuston net opening 1.0m wide by 0.5m tall, with a 333 µm mesh net. Zooplankton density recorded as wet volume displacement of zooplankton biomass per tow area (ml/m2).

[2] Spiny lobster larvae (Phyllosoma), eel larvae (Leptocephali), Lantern fish (Myctophids), and Cephalopods sorted from net contents and counted. Micronekton and gelatinous micronekton removed using a 1cm mesh sieve; biovolume (ml) recorded. Qualitative descriptions of micronekton removed from zooplankton biomass are available. Floating plastic, tar, and marine water striders (Halobates) removed from net contents, sorted, and recorded as numbers collected per tow.

Table 6. S-250 Meter Net Tow (MN) and 2-Meter Net Tow (2MN) data. Station locations and general locales are as given in Table 2. Quantitative 100-count data of zooplankton samples are available from SEA.

Station [1]	Tow depth (m) [2]	Tow Volume (m^3)	Zoo. Biomass (mL)	Zoo. Density (ml/m^3) [3]	Phyllo-soma (#)	Lepto-cephali (#)	Mycto-phids (#)	Cepha-lopods (#)	Other Nekton >2cm (#)	Total Nekton (#)	Total Nekton (ml)	Plastic Pellets (#)	Plastic Pieces (#)	Tar Pieces (#)	Halo-bates (#)	Gelatinous Organisms >2cm (#)	Gelatinous Organisms >2cm (ml)
S250-003-MN	~55	1434	34.0	0.024	2	0	0	0	1	3	0.5	0	0	0	0	0	0.0
S250-007-MN	~75	753	45.0	0.060	0	0	1	2	4	7	1.0	0	0	0	0	2	1.7
S250-011-MN	~55	695	13.5	0.019	0	0	0	0	0	0	0	0	0	0	0	3	3.0
S250-015-MN	~80	731	34.0	0.046	0	0	0	0	0	0	0	0	0	0	0	0	0.0
S250-022-MN [5]	~80	1047	80.0	0.076	0	0	3	0	0	3	1.7	0	0	0	0	16	340.0
S250-028-MN	~55	414	103.0	0.249	0	0	3	0	3	6	2.5	0	0	0	0	5	79.0
S250-034-MN [6]	~65	1119	141.0	0.126	0	0	2	0	1	3	500.2	0	0	0	0	30	29.0
S250-045-MN	~75	1119	131.0	0.117	0	0	6	0	7	13	1.7	0	0	0	0	14	37.5
S250-051-MN	~50	1178	133.5	0.113	0	0	11	0	10	21	5.5	0	0	0	0	31	20.5
S250-058-2MN	~400	7215	192.2	0.027	0	1	33	1	102	137	18.2	0	0	0	0	59	25.8

[1] Meter net (MN) mesh size = 333 µm; 2-Meter Net (2MN) mesh size = 1000 µm.

[2] Tow depths approximated based on wire angle, calculated from total wire deployed, ship speed, and angle at which wire entered the water.

[3] Zooplankton density recorded as wet volume displacement of zooplankton biomass per tow volume (ml/m^3).

[4] Spiny lobster larvae (Phyllosoma), eel larvae (Leptocephali), Lantern fish (Myctophids), and Cephalopods sorted from net contents and counted. Micronekton and gelatinous micronekton removed using a 1cm mesh sieve; biovolume (ml) recorded. Qualitative descriptions of micronedton removed from zooplankton biomass are available. Floating plastic, tar, and marine water striders (Halobates) removed from net contents, sorted, and recorded as numbers collected per tow.

[5] S-250-022-MN sample contained abundant >2cm gelatinous organisms, including 15 large salps (~320ml) and 1 large medusa (~20ml).

[6] S-250-034-MN sample included a large shark-like fish ~30cm in length (~500ml).

Table 7. S-250 Phytoplankton Net (PN) data. Station locations are given in Table 2.

Station	Date	Time (Local)	Sea Surface Temperature (°C) [2]	Chlorophyll Fluorescence (volts) [2]	Salinity (PSU) [2]	General Locale	Sample Type	Diatoms (%)[1]	Dino-flagellates (%)[1]
S250-003-PN	8-Nov-13	2101	18.6	1.6	33.69	California Current	Drifted Surface	n.d.	n.d.
S250-007-PN	10-Nov-13	2131	19.7	1.4	33.68	CA Current/NPSG	Drifted Surface	64	36
S250-011-PN	12-Nov-13	2134	21.5	1.2	34.39	NPSG	Drifted Surface	n.d.	n.d.
S250-014-PN	14-Nov-13	1031	22.8	1.2	34.83	NPSG	Drifted Surface	75	25
S250-015-PN	14-Nov-13	2111	22.7	1.3	34.85	NPSG	Drifted Surface	n.d.	n.d.
S250-017-PN	15-Nov-13	2210	25.0	1.3	34.64	NPSG	Drifted Surface	n.d.	n.d.
S250-020-PN	17-Nov-13	2218	26.1	1.3	34.51	NEC	Drifted Surface	n.d.	n.d.
S250-023-PN	19-Nov-13	1016	26.9	1.6	34.01	NEC	Drifted Surface	80	20
S250-024-PN	19-Nov-13	2233	26.9	1.9	33.90	NEC	Drifted Surface	n.d.	n.d.
S250-028-PN	21-Nov-13	2225	27.4	2.2	33.97	NECC	Drifted Surface	n.d.	n.d.
S250-032-PN	23-Nov-13	2108	28.0	3.6	34.74	NECC	Drifted Surface	n.d.	n.d.
S250-035-PN	25-Nov-13	1006	26.5	1.9	34.79	SEC	Drifted Surface	84	16
S250-036-PN	25-Nov-13	2214	26.4	4.5	34.82	SEC	Drifted Surface	n.d.	n.d.
S250-043-PN	28-Nov-13	2026	26.0	4.8	35.34	SEC	Drifted Surface	n.d.	n.d.
S250-047-PN	30-Nov-13	2210	26.9	4.1	35.49	SEC	Drifted Surface	n.d.	n.d.
S250-050-PN	2-Dec-13	1035	27.9	2.2	35.70	SEC	Drifted Surface	97	3
S250-051-PN	2-Dec-13	2225	28.0	4.6	35.80	SPSG	Drifted Surface	n.d.	n.d.
S250-062-PN	11-Dec-13	2212	28.3	5.3	35.50	SPSG	Drifted Surface	n.d.	n.d.

[1] n.d. = not determined.

[2] Sea surface temperature, chlorophyll fluorescence and salinity measurements from water samples collected in lab flow-through system while phytoplankton net was deployed.

Table 8. S-250 ARGO float deployments.

Station Number	Date	Time (Local)	Latitude	Longitude	Float Serial Number	Wave Height (m)	Winds (Beaufort Force)	Sea Surface Temperature (°C)	Salinity (PSU)	Nearest S-250 Hydrocast
S250-037	26-Nov-13	0719	01°52.6'N	135°31.1'W	F0170 (#5904278)	2	4	26.3	34.85	S250-036-HC
S250-039	27-Nov-13	0522	00°00.1'S	136°08.7'W	F0167 (#5904275)	2	4	25.2	34.95	S250-040-HC

Both ARGO floats were constructed by and will receive continued support from NOAA Pacific Marine Environmental Laboratory ARGO Program (http://floats.pmel.noaa.gov/). Float tracking and processed data may be accessed through the float database at the provided website.

Table 9. S-250 sediment data.

Station	Date	Time	Lat. (S)	Long. (W)	Water Depth (m)	General Locale	Sediment Size Analysis (%)									Qualitative Description
							>4 mm	3-4 mm	2-3 mm	1-2 mm	0.5-1 mm	0.25-0.5 mm	0.125-0.25 mm	0.63-0.125 mm	<0.63 mm	
S250-053-SGA	4-Dec-13	0921	8°56.9'	140°03.3'	85.8	Nuku Hiva (nearshore)	0.1	0	0.2	8.1	54.7	18.9	15.8	2.2	0	Light olive gray (5Y 5/2) coarse sand composed of angular shell and coral fragments, and subangular quartz, feldspar, and mafic particles.
S250-053-SGB	4-Dec-13	1037	8°55.6'	140°06.1'	35.0	Nuku Hiva (Taiohae Bay)	0	0	0.5	2.0	7.6	14.5	29.8	5.8	39.8	Olive gray (5Y 4/1) fine sand composed of angular shell fragments, and subangular quartz, feldspar, and mafic particles. Sample included abundant tube worms.
S250-066-MISC	13-Dec-13	1200	16°03.3'	145°37.6'	~6	Fakarava (at anchor in lagoon)	5.0	0.0	34.0	23.0	19.0	8.2	5.1	2.2	3.5	Yellowish gray (5Y 7/2) very coarse shell and coral carbonate sand, granules, and pebbles. Minor quartz sand particles. (Sample collected from bottom by swimmer.)

STUDENT RESEARCH PROJECT ABSTRACTS -

An Exploration of the Relationship Between Barrier Layers and Tropical Cyclones in the Eastern Pacific

Maya Becker and Elina Berglund

Tropical cyclone intensification, driven by warm sea surface temperatures, has recently been linked to barrier layer presence. A barrier layer (BL) is a layer of seawater that forms when the pycnocline and thermocline occur at different depths. This change in upper ocean structure limits vertical mixing, thereby trapping warm water near the surface. We investigated the relationship between barrier layers and tropical cyclones in the eastern Pacific and expected to see a direct correlation between the two. Our study examined temperature, salinity, and pressure data from three Sea Education Association research cruises—S-214, S-220, and S-250—each of which occurred during a different El Niño Southern Oscillation (ENSO) phase. These data were used to analyze barrier layer presence in relation to level of regional tropical cyclone activity in the three to six months prior to each cruise track. S-220 showed the strongest direct correlation, with 33% barrier layer presence in the 10-degree latitudinal range along the cruise track where tropical cyclones had occurred. The data did not indicate as strong of a correlation for S-214 and S-250 (9% BL presence and 0% BL presence, respectively), but this may be explained by current-induced barrier layer drifting and differences in ENSO phase. Further exploration is required to establish the role of barrier layers in tropical cyclone development.

Examining Characteristics of Barrier Layers and Their Formation in the Subtropical Pacific

Ellen Bechtel and Mikasa Quaife

The upper ocean layers are a dynamic environment influenced by numerous external factors. These layers can enable or inhibit vertical mixing and control the physical properties of the water, A barrier layer (BL) is an isothermal layer below the pycnocline which is stratified by density and prevents mixing between the surface and deep layers, which in turn affects nutrient mixing and tropical storm formation. Formation mechanisms for BLs are unclear although research suggests many possibilities such as increased precipitation or decreased winds. We examined CTD profiles collected in the subtropical Pacific Ocean on four SEA cruise tracks (S-220, S-240, S-244, and S-250). We hypothesized that location, wind, cloud cover, sea surface temperature, sea surface salinity, thermocline depth and temperature, pycnocline depth and temperature, or a combination of these would be significantly different between profiles with and without BLs. We found BLs in 24 of the 130 profiles analyzed (21%). Thermocline depth was the only variable that was statistically different in BL and non-BL ocean profiles. This suggests that the thermocline deepens and the pycnocline remains stationary when a BL forms. Similarly, the results of a Principle Component Analysis (PCA) also suggest that an increased thermocline depth occurs where BLs exist. We found that only 13 of 55 environmental conditions co-varied in BL locations, compared with 37 of 55 in non-BL locations, which suggests that the external factors we chose as variables were not sufficient to predict BL characteristics. Future research should explore different variables such as proximity to currents, precipitation and air temperature.

Relationships of Food Availability to Thecosomatous Pteropod Abundance, Diversity, and Distribution in the Southeast Pacific

Robin Alexis Byron and Elly Fireside-Ostergaard

Thecosome pteropods are important members of pelagic oceanic ecosystems worldwide, acting as major grazers of phytoplankton and contributing to the oceanic carbon cycle. This study examined pteropod distribution and abundance along the track of SEA Cruise S-250, transecting a region from San Diego, California to Papeete, Tahiti. Additionally, we related pteropod density and species distribution to chlorophyll-*a* levels (used as a measure of phytoplankton abundance) and zooplankton density, both indicators of food availability. We collected plankton samples from 9 stations in five different current systems using oblique meter net tows to 50m water depth. We removed, counted, and speciated pteropods from these samples, and compared these data to measures of food availability from the same locations. Pteropod density was highest in the North Equatorial Countercurrent (2.84 individuals/m^3) and in the California Current (1.88 individuals/m^3). The lowest pteropod density was in the North Pacific Subtropical Gyre (average 0.12 individuals/m^3). Diversity showed a weak inverse relationship with density, with the highest diversity found in the North Pacific Subtropical Gyre. In all samples, the genus *Limacina* dominated the tows. Pteropod density and diversity showed no significant correlation with chlorophyll-*a* content or zooplankton density. This could be due to the inadequacy of chlorophyll-*a* and zooplankton density as accurate indicators of food availability and due to small sample size.

Effect of Low pH on the Growth Rate of Phytoplankton in the Eastern Pacific Ocean

Alice Chapman and Michelle Muth

Atmospheric carbon dioxide (CO_2) has been steadily increasing since pre-industrial times due to human carbon emissions, which corresponds to a decrease in ocean pH. This drop in pH affects the metabolic and biological processes of phytoplankton, key players in the carbon cycle due to their role in carbon sequestration. This study investigates the effect of low pH on phytoplankton growth along the portion of our cruise track from San Diego, CA to Nuku Hiva via a series of five incubation experiments. Each incubation sampled surface water from a distinct marine environment and phytoplankton collected were grown at ambient pH (control) and at a lowered pH of about 7.7 (treatment). At the beginning and end of each incubation, chlorophyll-*a*, alkalinity, and pH were measured to calculate phytoplankton growth rate and change in pCO_2. A phytoplankton net was deployed at each sampling location and a 100-count was conducted to determine the community structure. Treatment phytoplankton growth rates were on average 0.24 µg/day lower than control growth rates for all five experiments, which agrees with what we had expected. pH decreased by an average of 0.25 and pCO_2 increased by an average of 563µatm over the course of all five incubations for both conditions, which may be due to a greater incidence of cellular respiration than photosynthesis. The decrease in growth rate may be attributed to an inability to maintain internal pH, changes in metal speciation, pH-dependent enzyme reaction rates, or a combination of all three. Further experimentation would investigate the weight of these potential causes.

Comparing Carbon Flux in the Equatorial Pacific

Maddy Gold and Kit Pavlekovsky

Carbon flux is the exchange of carbon dioxide (CO_2) between the atmosphere and the oceans, and is an essential process in global climate regulation. There is an extensive published database for estimating flux during ENSO neutral years; however, there is a large data gap in the eastern Pacific basin where the database extrapolates flux based on sparse measurements. Prior studies have shown that CO_2 flux varies during ENSO cycles, with flux increasing during La Niñas and decreasing during El Niños. We determined flux along the SEA S-250 cruise track from San Diego, CA, USA to Fakarava, French Polynesia and compared it to the published database, as well as to data from previous SEA cruises during different ENSO states. pH and alkalinity were measured at 58 stations and used to calculate pCO_2 which was then used to determine flux. This study was conducted during an ENSO neutral period, therefore flux was predicted to be lower than La Niña cycles and higher than El Niño cycles. Flux along the cruise track varied between -1.6 and 0.56 µmol/m2/month with highest air-sea CO_2 flux at 19°N and the lowest air-sea CO_2 flux at 30°N. The highest sea-air flux occurred near 10°N and was likely due to increased sea state, wind speed and cloud cover. Compared to the published database, flux from S-250 was consistently more negative. When compared to data from past SEA cruises, the flux data from S-250 is statistically different from El Niño data ($p=0.012$), but not statistically different from La Niña data ($p=0.85$).

A Comparison of Nitrite and Nitrate Profiles Through Varying Current Systems in the Eastern Pacific

Kalina C. Grabb and Robert J. Hollis

Nitrite and nitrate are usually limiting nutrients in photosynthesis and are produced by separate microbial communities that have specific light restrictions. In stratified waters these communities become localized due to these light restrictions, which eliminate competition for the standing stock of nutrients and allow a Primary Nitrite Maximum (PNM) to form. This study focused on how the PNM changes in various oceanographic regions with differing levels of stratification along the SEA S-250 cruise track from San Diego, California to Papeete, Tahiti. In well-mixed waters such as upwelling regions we expected to observe homogenous nutrient profiles. As the waters became more stratified, such as in gyre regions, we expected to observe a well-defined PNM. We collected water samples at six sample stations representing a diversity of environments, and determined nitrite, nitrate and chlorophyll-*a* concentrations in the upper 400 meters of the water column. At each sample station, vertical nutrient profiles show a PNM between the depths of 60 -173 meters, which lies beneath the chlorophyll-*a* maximum. The profiles showed an inverse relationship between nitrite and nitrate, with nitrate increasing below the PNM. In upwelling regions, a shallow PNM was observed (average depth = 86.67 meters), whereas in the gyres a well-defined PNM occurred at greater depths (average depth = 147.67 meters), showing the localization of microbial communities as expected. This exploratory study adds to the limited research on the complex nitrogen cycle in the eastern Pacific and its ecological implications.

Phytoplankton Abundance Response to Trace Metal Incubation in the Central Pacific

Katherine Hays

Phytoplankton play a huge role in the marine ecosystem. Not only do they account for nearly half of all photosynthetic activity on Earth, but they also form the base of the marine food web. This study explored the potential of copper, cadmium and manganese to influence primary production and attempted to identify concentrations of each of these trace metals that are toxic to phytoplankton communities in the central Pacific. Four incubation experiments were run at unique water sampling locations along cruise track S-250, between San Diego, CA and Tahiti. Water samples were filtered to isolate pico- and nanoplankton, spiked with varying concentrations of trace metal solutions, incubated, and then analyzed for chlorophyll-*a* content. Copper was the only trace metal to demonstrate a significant toxicity level within the concentrations tested, with phytoplankton communities showing significant lesser amounts of growth at concentrations equal to or greater than 160 nmol/liter. Cadmium and manganese results were less clear, and it may be that the incubation experiments did not test concentrations high enough to reach toxic levels of either trace metal. As industrialization continues to be a source of trace metals into the ocean, monitoring the quality of our waters will continue to be needed so that we do not adversely affect the important phytoplankton communities there.

A Comparison of Current Measurement Instrumentation: ADCP versus Geostrophic Equations

Robert Alexander Kovell and James Crawford

A quantitative understanding of the world's oceans is integral to successful climate modeling. This includes reliable and accurate measurements of ocean currents. We analyzed current velocities on board the *SSV Robert C. Seamans* during the cruise track S-250 from San Diego to Nuka Hiva. In order to investigate the degree to which the two primary ocean current methodologies agreed, we utilized Ocean Data View to calculate geostrophic currents from hydrocast data and compared these to measurements from a ship-mounted Acoustic Doppler Current Profiler (ADCP) and published Pacific equatorial current system data. Throughout the cruise we observed the expected Pacific Equatorial Currents, but found that in selected areas the ADCP and calculated geostrophic flows generated significantly differing magnitudes. Geostrophic equations measured current magnitudes at 1.8% of the ADCP values in the Northern Pacific Subtropical Gyre, 18% in the Northern Equatorial Current, 66% in a high magnitude current observed in the ADCP data at 9°N, approximately equivalent magnitudes in the Northern Equatorial Countercurrent, and 248% of the ADCP values in the South Equatorial Current. These differences may be due to regions of non-geostrophic flow and/or current movement parallel to our cruise track. Additionally, we visually compared transmissometer profiles to ADCP backscatter plots. The observed decrease in particle density by depth was expected due to a decrease in organisms living below the photic zone in the water column. However, neither profile decreased to zero indicating enough scatterers throughout our cruise track for effective ADCP functionality in the upper 600 m of the water column.

The Impacts of Ocean Acidification on the Geographic Distribution, Abundance, Species Composition and Species Diversity of Oceanic Thecosome Pteropods in the Southeast Pacific

Camille Pagniello

Thecosome pteropods are shell-forming planktonic gastropods, which are sensitive to ocean acidification due to their aragonite shells. This study investigated how continued ocean acidification will impact the geographic distribution, total abundance, species composition and species diversity of oceanic thecosome pteropods in the southeast Pacific. Pteropods were collected at nine stations along the cruise track with a 333 μm-mesh meter net. At the same locations, hydrographic measurements and seawater samples were collected with a CTD and in Niskin bottles, respectively. Pteropods were counted and speciated using a dissecting microscope. Total abundance, species composition and species diversity were compared with latitude, pH, total carbonate alkalinity (TCA), sea surface temperature (SST), dissolved inorganic carbon (DIC), and aragonite saturation state ($\Omega_{aragonite}$). Total abundance, species composition and species diversity were not significantly associated with SST, pH, TCA, DIC or $\Omega_{aragonite}$. Species composition in the same general locale tended to be similar. *Limacina spp.* were the most common pteropods present along the cruise track and often dominated the species composition. Pteropod communities with low abundances typically had high species diversities, and no dominating species. The results of this experiment suggest that although ocean acidification is increasingly becoming a threat to pteropods, it is not currently affecting these organisms in their natural environment in a way that can be definitively measured.

Phytoplankton Size Distribution in the Eastern Pacific as a Function of Latitude, Nitrate, pH, Alkalinity, and Temperature

Caitlin Russell

Phytoplankton play an important role in marine ecosystems, accounting for half of all photosynthetic activity on earth and forming the base of the food chain. Phytoplankton size distribution influences key factors such as carbon export and food web dynamics and varies between different ocean environments. This study investigated the size distribution of chlorophyll-*a* (a proxy for primary productivity) along the cruise track of SEA Cruise S-250, an eastern Pacific meridional transect from San Diego to Tahiti. Fourteen water samples were collected from 10m depth in addition to deep samples above and below the deep chlorophyll maximum (DCM) in five distinct environments, filtered onto 0.3 μm, 3 μm, and 8 μm Millipore MF membrane filters, and analyzed for chlorophyll-*a* content. These data were then compared to latitude, depth, nitrate, temperature, alkalinity, and pH. Samples from 10m water depth varied significantly from each other along the cruise track, but not compared to latitude. However, visually the percentage of chlorophyll in the large (>8 μm) size range was clearly higher in the California Current than further offshore, supporting expectations. Contrary to expectations, no significant correlations were observed between chlorophyll size distribution and temperature, pH, alkalinity, or pH. At deep stations, the percentage of chlorophyll in the >8 μm size range tended to increase with depth but again was not correlated to nitrate concentration. This may be due partly to lack of sample resolution. In a changing ocean, monitoring how phytoplankton size distribution changes will continue to be important due to far-reaching impacts on carbon cycling and energy transport.

Controlling Factors of AOU in the South Pacific

Suzette Shipp

This project examined apparent oxygen utilization (AOU), an indicator of primary production, in the eastern equatorial Pacific Ocean, and looked for relationships between AOU and dissolved oxygen (DO), chlorophyll-*a* values, and nutrient abundance. Data were collected at 60 hydrocast stations during SEA Cruise S-250, from San Diego to Tahiti. AOU was calculated by subtracting probe-determined DO of water in the upper 600m of the ocean from the theoretical maximum DO calculated based on that water's CTD-determined physical characteristics. DO was strongly inversely correlated with AOU (R^2=0.9703), which was expected as water depths characterized by high primary productivity (producing oxygen) would result in the most negative AOU values. Nitrate and phosphate were both directly correlated with AOU (R^2=0.7517 and R^2=0.8299, respectively), which was also expected as respiration and decomposition processes consume oxygen (resulting in more positive AOU values) and release nutrients back to the water column. Contrary to expectations, chlorophyll-*a* was inversely correlated with AOU, although this correlation was quite weak. Further work remains to determine how results of this cruise indicate about oxygen minimum zones or possible hypoxia trends in the eastern Equatorial Pacific.