

data report

PHYSICAL, CHEMICAL AND CURRENT METER DATA

CalCOFI CRUISE 7601
6–7 January 1976

CalCOFI CRUISE 7602
16–20 February 1976

CRUISE 7603 (TWATE III)
30 March–2 April 1976

CRUISE 7604
17 April–10 May 1976

CRUISE 7611
11 November 1976

SIO Reference 88-4
29 February 1988

UNIVERSITY OF CALIFORNIA
SCRIPPS INSTITUTION OF OCEANOGRAPHY

PHYSICAL, CHEMICAL AND CURRENT METER DATA

CalCOFI CRUISE 7601
6-7 January 1976

CalCOFI CRUISE 7602
16-20 February 1976

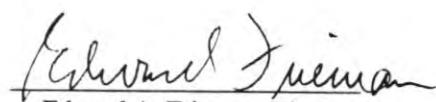
CRUISE 7603 (TWATE III)
30 March-2 April 1976

CRUISE 7604
16 April-10 May 1976

CRUISE 7611
11 November 1976

SIO Reference 88-4
29 February 1988

Approved for distribution:


Edward A. Frieman, Director

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INTRODUCTION

The data in this report were collected during CalCOFI Cruises 7601* and 7602, and Cruises 7603 and 7604 aboard the RV *Alexander Agassiz*, and Cruise 7611 aboard the RV *Ellen B. Scripps* of the Scripps Institution of Oceanography, University of California, San Diego. Although all these cruises were in the area of the California Cooperative Oceanic Fisheries Investigations (CalCOFI), only during 7601 and 7602 were planned CalCOFI station positions occupied. Cruise 7603 was a Two-Way Acoustic Transmission Experiment (TWATE III) on which the principle work accomplished was sound velocity analyses in the vicinity of locations 33°N, 118°W and 31°N, 120°W. The object of Cruise 7604 was to investigate eddies in the California Current, to determine their size, their movement in relationship to other currents, and the length of time they remain a distinguishable feature. A series of airborne expendable bathythermographs (AXBTs) used in a program to observe the thermal structure in the Central Pacific were calibrated by comparison with eight STD lowerings during Cruise 7611. This field program has been described in SIO Reference 76-19, Observation of Thermal Structure in the Central Pacific, T. P. Barnett, M. H. Sessions, and P. M. Marshall.

These data were collected and processed by personnel of the Data Collection and Processing Group, Marine Life Research Group (DCPG**, MLRG), Scripps Institution of Oceanography.

STANDARD PROCEDURES

The difference in purpose of the five cruises in this report results in a variation of the data collected. Hydrographic casts were made on all cruises but varied from only one cast of eight Nansen bottles on the STD wire for Cruise 7601 to 20 casts of 18 Nansen bottles on the hydrographic wire for Cruise 7604. Temperature and salinity were determined for all depths sampled. Oxygen and nutrients were determined for Cruise 7602 only. On Cruise 7601 the four free vehicle current meters which had been deployed during CalCOFI Cruise 7510 were recovered.

On STD lowerings during Cruises 7601, 7602, 7603, and 7611 where hydrographic casts were not made, a Nansen bottle was usually placed a few meters above the STD and another bottle was lowered to approximately 10 meters. During Cruise 7602, both down and up recordings from the STD were made on two separate DDL systems as well as analog traces for all lowerings.

Paired protected reversing thermometers were used on all Nansen bottle casts to determine temperatures which are recorded to hundredths of a degree Celsius. Sampling bottles used below a depth of 100 meters were equipped with unprotected thermometers for determination of depth of sampling.

Salinity samples were determined at sea using inductive-type salinometers. The salinity values are recorded to three decimal places.

Dissolved oxygen on Cruise 7602 was determined by the Winkler method as modified by Carpenter (1965), using the equipment and procedure outlined by Anderson (1971).

Silicate, nitrate and nitrite for Cruise 7602 were determined at sea using an automated analyzer. The procedures used are similar to those described in Atlas *et al.* (1971). Phosphate samples were determined using a Gilford modified DU spectrophotometer. Reactive phosphate was analyzed using the method of Murphy and Riley (1962), with the specific procedure outlined by Anderson (1971).

The observed data have been evaluated using the methodology described by Klein (1973). This involves consideration of their variation as functions of density or depth and their relations to each other, and comparisons with adjacent observations.

The STD data for Cruises 7601, 7604, and 7611 were processed by computer from the DDL recordings and appear to compare well with the hydrographic data. Although extra effort was made on Cruise 7603 to compare the STD recordings on two separate DDL instruments, the tabulated data were digitized from the analog traces and also

* The first two digits represent the year and the last digits the month of the cruise.

** Now the Oceanographic Data Facility (ODF).

appear to compare well with the hydrographic data.

TABULATED DATA

The reported hydrographic cast time is the Greenwich Mean Time (GMT) of the messenger release. Bottom depths, determined acoustically, have been corrected using Matthews (1939) tables and are reported in meters. Weather conditions have been coded using WMO code 4051.

Data tabulations are presented in the following forms:

- 1) Data from the sample bottle casts are tabulated with the observed levels of depth on the left of the page, and standard depth values of temperature, salinity and oxygen interpolated from these observations are on the right of the page. Additional computed values are also presented.
- 2) Data from the STD lowerings are presented with two stations printed side by side. Temperature and salinity are tabulated at closer standard intervals than the interpolated standard depth bottle data. Additional computed values are also presented.
- 3) Calibration of the AXBTs on Cruise 7611 required the data from the STD to be tabulated at approximately 10 meter intervals of depth. The additional computed values are tabulated for each depth.
- 4) Current meter speed and direction data were calculated over one-half-hour intervals. This report includes only the resultant speeds and directions for the entire record lengths.

The same parameters have been tabulated in this report as in previous reports. Cruises 7601 and 7602 have the CalCOFI station designations which have been in use for over thirty years. The first part specifies a line normal to the general trend of the coastline (CalCOFI line). The second part specifies a station position relative to the coast on the CalCOFI line. On some closely-spaced special inshore stations, an additional superscript number may appear after the line number or station number to indicate a finer resolution of the non-standard station location.

The column headings are to be interpreted as follows:

Z	Depth	Meters
T	Temperature	°C
S	Salinity	‰
O ₂	Dissolved Oxygen	ml/L
PO ₄	"Reactive" inorganic phosphate-phosphorous	µg at/L
SiO ₃	"Reactive" inorganic silicate-silicon	µg at/L
NO ₂	"Reactive" nitrite-nitrogen	µg at/L
NO ₃	"Reactive" nitrate-nitrogen	µg at/L
DT	δ _T Thermometric anomaly	µg at/L
SIGT	σ _t = (ρ _{s,t,0} - 1) 10 ³ where ρ _{s,t,0} is the density the parcel of sea water would have if moved isothermally to the sea surface.	cl/ton g/L
DD	Geopotential anomaly, referred to the sea surface.	dyn. meters

LITERATURE CITED

- Anderson, G. C., compiler, 1971. "Oxygen Analysis," Marine Technician's Handbook, SIO Ref. No. 71-8, Sea Grant Pub. No. 9.
- Anderson, G. C., compiler, 1971. "Phosphate Analysis," Marine Technician's Handbook, SIO Ref. No. 71-10, Sea Grant Pub. No. 11.
- Atlas, E. L., J. C. Callaway, R. D. Tomlinson, L. I. Gordon, L. Barstow, and P. K. Park, 1971. *A Practical Manual for Use of the Technicon^R AutoAnalyzer^R in Sea Water Nutrient Analysis*; Revised. Oregon State University Technical Report 215, Reference No. 71-22.
- AutoLab Ind. Pty. Ltd., Sydney, 1960. Inductively Coupled Salinometer MK 111, Model 601, Operating Inst. and Ills. Parts List.
- Bissett Berman Corporation, 1967. Operation and Maintenance Manual, Laboratory Salinometer Model 6220.
- Bissett Berman Corporation, 1970. Instruction Manual, Laboratory Salinometer Model 6230N.
- Carpenter, J. H., 1965. The Chesapeake Bay Institute technique for the Winkler dissolved oxygen method. *Limnol. Oceanogr.*, 10: 141-143.
- Klein, Hans T., 1973. A new technique for processing physical oceanographic data. SIO Ref. No. 73-14.
- Matthews, D. J., 1939. Tables of the velocity of sound in pure water and seawater for use in echo-sounding and sound-ranging. Second Edition. Hydrographic Department, Admiralty, H. D. 282, 52 pp.
- Murphy, J., and J. P. Riley, 1962. A modified single solution method for the determination of phosphate in natural waters. *Anal. Chem. Acta*, 27: 31.
- Plessey Environmental Systems, 1974. Instruction Manual, *In situ* Salinity/Temperature/Depth Monitoring and Recording System, Model 9040.
- Strickland, J. D. H., and T. R. Parsons, 1968. A practical handbook of seawater analysis. *Fish. Res. Brd. Can., Bull.*, 167: 311 pp.
- Sverdrup, H. U., M. W. Johnson, and R. H. Fleming, 1942. *The Oceans: their Physics, Chemistry, and General Biology*. Prentice-Hall, New Jersey, 1087 pp.

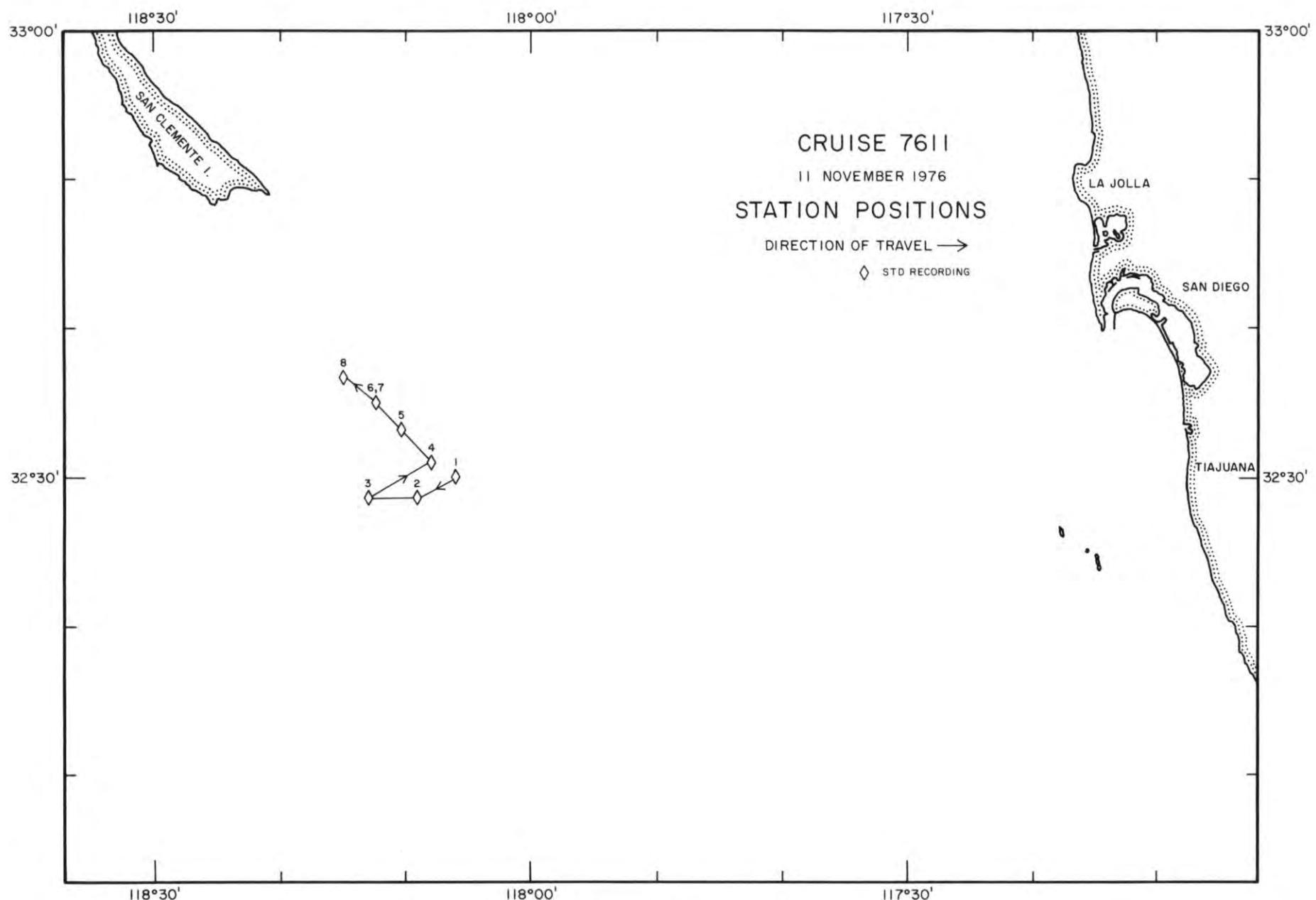


FIGURE 5

PERSONNEL

Cruise 7611

SHIP'S CAPTAIN

Davis, Laurence E., RV *Ellen B. Scripps*

PERSONNEL PARTICIPATING IN THE COLLECTION OF DATA

Sessions, Meredith H.	Principal Development Engineer, SIO (in charge)
Bryan, Cindy L.	
Bryan, Walter R.	Marine Technician, SIO
Dillon, Laurie A.	Student, Fullerton Junior College
Singleton, James R.	Electronics Technician, SIO
Thomas, Julianna O.	Lab Assistant, SIO
Wald, Steve	Asst. Development Engineer, SIO

STATION STD 1					RV ELLEN B. SCRIPPS					CRUISE 7611					STATION STD 2						
LATITUDE	LONGITUDE	MO/DAY/YR	START TIME	BOTTOM	LATITUDE	LONGITUDE	MO/DAY/YR	START TIME	BOTTOM	Z	T	S	SIGT	DT	DD	Z	T	S	SIGT	DT	DD
32 30.2 N	118 06.2 W	11/11/76	0037 GMT	M	32 28.6 N	118 09.0 W	11/11/76	0153 GMT	M												
WIND SPEED	WAVES	WEA	BAROMETER	DRY	WET	CLOUDS	WIND SPEED	WAVES	WEA	Z	T	S	SIGT	DT	DD	Z	T	S	SIGT	DT	DD
1	20.26	33.89	23.869	404.4	0.004		1	20.19	33.87	23.872	404.1	0.004									
11	20.25	33.89	23.872	404.2	0.044		12	20.19	33.89	23.887	402.7	0.048									
21	20.12	33.89	23.906	400.9	0.085		15	20.19	33.89	23.887	402.7	0.061									
23	20.06	33.90	23.929	398.7	0.093		20	20.06	33.91	23.937	398.0	0.081									
25	19.95	33.90	23.958	396.0	0.101		30	19.02	33.91	24.205	372.4	0.119									
32	18.95	33.98	24.276	365.7	0.128		33	17.91	33.88	24.458	348.3	0.130									
37	16.58	33.78	24.698	325.5	0.145		40	17.02	33.74	24.564	338.2	0.154									
41	16.07	33.69	24.746	320.9	0.158		43	16.07	33.76	24.799	315.8	0.164									
47	15.11	33.71	24.975	299.0	0.176		50	15.28	33.74	24.961	300.4	0.186									
52	14.14	33.71	25.182	279.3	0.191		60	13.18	33.73	25.395	259.1	0.214									
62	12.19	33.68	25.549	244.4	0.217		64	12.35	33.64	25.488	250.2	0.224									
67	11.62	33.64	25.626	237.2	0.229		71	11.47	33.66	25.669	233.1	0.241									
71	11.26	33.71	25.746	225.7	0.239		82	10.59	33.69	25.850	215.9	0.266									
82	10.46	33.70	25.880	213.0	0.263		91	10.24	33.75	25.957	205.7	0.285									
92	10.23	33.74	25.951	206.2	0.284		100	10.01	33.77	26.012	200.5	0.304									
102	9.90	33.79	26.046	197.2	0.305		111	9.81	33.80	26.069	195.0	0.325									
111	9.66	33.82	26.109	191.2	0.322		120	9.59	33.85	26.144	187.9	0.343									
120	9.48	33.85	26.162	186.2	0.339		130	9.47	33.84	26.156	186.8	0.362									
132	9.35	33.87	26.199	182.7	0.362		140	9.34	33.87	26.201	182.5	0.381									
141	9.18	33.91	26.258	177.1	0.378		149	9.21	33.91	26.253	177.6	0.397									
152	9.05	33.93	26.294	173.7	0.398		161	9.08	33.92	26.281	174.8	0.419									
162	8.92	33.94	26.323	170.9	0.415		170	8.95	33.97	26.341	169.2	0.434									
170	8.78	33.97	26.368	166.6	0.429		180	8.75	33.99	26.388	164.7	0.451									
180	8.68	34.00	26.407	162.9	0.446		191	8.55	34.03	26.451	158.8	0.470									
190	8.51	34.02	26.449	158.9	0.462		200	8.44	34.05	26.483	155.7	0.484									
201	8.38	34.05	26.492	154.8	0.480		210	8.31	34.07	26.519	152.3	0.500									
212	8.32	34.06	26.509	153.2	0.497		220	8.28	34.08	26.531	151.2	0.515									
221	8.28	34.07	26.523	151.9	0.511		229	8.20	34.10	26.559	148.5	0.529									
231	8.23	34.09	26.547	149.7	0.527		240	8.17	34.12	26.579	146.6	0.546									
241	8.20	34.11	26.567	147.8	0.542		250	8.13	34.13	26.593	145.3	0.561									
252	8.13	34.13	26.593	145.3	0.559		261	8.10	34.15	26.613	143.4	0.577									
261	8.09	34.14	26.607	144.0	0.572		270	8.07	34.18	26.641	140.7	0.590									
272	8.03	34.17	26.639	140.9	0.588		280	7.99	34.20	26.669	138.1	0.605									
281	7.94	34.19	26.668	138.1	0.601		290	7.89	34.20	26.683	136.7	0.619									
292	7.88	34.19	26.677	137.3	0.617		300	7.87	34.21	26.694	135.7	0.633									
302	7.78	34.18	26.684	136.6	0.631		310	7.75	34.23	26.727	132.5	0.647									
312	7.65	34.21	26.726	132.6	0.645		320	7.64	34.22	26.736	131.7	0.661									
321	7.60	34.21	26.734	131.9	0.658		330	7.52	34.21	26.745	130.8	0.675									
332	7.54	34.22	26.750	130.4	0.673		340	7.50	34.21	26.748	130.6	0.688									
342	7.50	34.22	26.756	129.8	0.686		352	7.39	34.22	26.772	128.3	0.704									
349	7.49	34.23	26.765	128.9	0.696		354	7.39	34.22	26.772	128.3	0.707									

STATION STD 3					RV ELLEN B. SCRIPPS					CRUISE 7611					STATION STD 4						
LATITUDE	LONGITUDE	MO/DAY/YR	START TIME	BOTTOM	LATITUDE	LONGITUDE	MO/DAY/YR	START TIME	BOTTOM	Z	T	S	SIGT	DT	DD	Z	T	S	SIGT	DT	DD
32 28.7 N	118 13.2 W	11/11/76	0613 GMT	M	32 31.0 N	118 08.1 W	11/11/76	1555 GMT	M												
WIND SPEED	WAVES	WEA	BAROMETER	DRY	WET	CLOUDS	WIND SPEED	WAVES	WEA	Z	T	S	SIGT	DT	DD	Z	T	S	SIGT	DT	DD
1	20.07	33.88	23.911	400.4	0.004		2	19.94	33.83	23.907	400.8	0.040									
10	20.07	33.89	23.919	399.7	0.040		10	19.94	33.83	23.907	400.8	0.080									
17	20.07	33.89	23.919	399.7	0.068		20	19.94	33.83	23.907	400.8	0.118									
21	19.90	33.92	23.986	393.3	0.084		30	17.99	33.74	24.331	360.3	0.150									
28	17.97	33.92	24.473	346.8	0.110		39	16.77	33.73	24.615	333.3	0.184									
30	17.45	33.88	24.569	337.7	0.117		45	16.10	33.74	24.777	317.9	0.169									
36	15.89	33.77	24.848	311.1	0.136		50	14.48	33.81	25.187	278.8	0.184									
40	15.20	33.74	24.978	298.7	0.149		57	13.05	33.66	25.366	261.8	0.203									
42	14.95	33.71	25.010	295.7	0.154		60	12.58	33.60	25.413	257.4	0.211									
48	12.94	33.74	25.450	253.8	0.171		70	11.57	33.69	25.674	232.6	0.236									
50	12.55	33.75	25.534	245.8	0.176		80	10.74	33.77	25.886	212.4	0.258									
60	11.62	33.62	25.610	238.6	0.200		91	10.38	33.73	25.917	209.4	0.282									
62	11.54	33.63	25.633	236.5	0.205		99	10.05	33.79	26.021	199.6	0.298									
70	10.90	33.76	25.849	215.9	0.223		102	10.00	33.78	26.021	199.6	0.304									
80	10.55	33.74	25.896	211.5	0.245		110	9.82	33.81	26.											

STATION	STD	5	RV ELLEN B. SCRIPPS				CRUISE 7611				STATION	STD	6
LATITUDE	LONGITUDE	MO/DAY/YR	START TIME	BOTTOM	LATITUDE	LONGITUDE	MO/DAY/YR	START TIME	BOTTOM				
		11/11/76	1820	GMT			11/11/76	2009	GMT				
WIND	SPEED	WAVES	WEA	BAROMETER	DRY	WET	CLOUDS	WIND	SPEED	WAVES	WEA	BAROMETER	DRY
Z	T	S	SIGT	DT	DD			Z	T	S	SIGT	DT	DD
1	19.96	33.83	23.902	401.3	0.004			1	19.99	33.87	23.925	399.1	0.004
11	19.98	33.85	23.912	400.3	0.044			9	19.98	33.87	23.927	398.9	0.036
20	19.97	33.86	23.922	399.4	0.080			14	19.98	33.87	23.927	398.9	0.056
21	19.97	33.86	23.922	399.4	0.084			20	19.98	33.87	23.927	398.9	0.080
30	18.01	33.92	24.464	347.7	0.118			30	18.18	33.92	24.422	351.7	0.117
35	17.11	33.79	24.581	336.6	0.135			34	16.95	33.81	24.634	331.5	0.131
40	16.02	33.90	24.918	304.5	0.151			38	15.85	33.78	24.864	309.6	0.144
43	15.00	33.86	25.114	285.8	0.160			40	15.32	33.79	24.990	297.6	0.150
52	12.91	33.80	25.502	248.9	0.184			44	13.93	33.72	25.234	274.4	0.162
59	12.10	33.66	25.551	244.2	0.202			50	12.85	33.74	25.468	252.2	0.177
64	11.92	33.62	25.554	243.9	0.214			60	11.94	33.62	25.550	244.3	0.202
70	11.35	33.87	25.853	215.5	0.228			71	10.78	33.62	25.762	224.2	0.228
80	10.53	33.73	25.891	211.9	0.249			80	10.54	33.67	25.843	216.5	0.248
90	10.25	33.77	25.971	204.3	0.270			89	10.32	33.71	25.912	209.9	0.268
92	10.18	33.77	25.983	203.2	0.274			101	10.14	33.75	25.974	204.0	0.293
100	9.92	33.80	26.050	196.8	0.290			110	9.89	33.78	26.040	197.8	0.311
109	9.71	33.81	26.093	192.7	0.308			121	9.68	33.81	26.098	192.3	0.333
122	9.44	33.87	26.184	184.1	0.333			132	9.49	33.83	26.145	187.8	0.354
131	9.25	33.90	26.239	178.9	0.350			142	9.22	33.89	26.236	179.2	0.373
139	9.16	33.91	26.261	176.8	0.364			151	8.92	33.90	26.291	173.9	0.389
150	8.93	33.91	26.298	173.3	0.384			160	8.81	33.95	26.348	168.5	0.404
161	8.78	33.93	26.337	169.6	0.403			170	8.72	33.98	26.385	165.0	0.421
170	8.74	33.97	26.374	166.0	0.418			180	8.53	33.99	26.423	161.4	0.438
180	8.65	33.99	26.404	163.2	0.435			191	8.50	34.00	26.435	160.3	0.456
190	8.54	34.00	26.429	160.9	0.451			201	8.38	34.05	26.492	154.8	0.472
200	8.36	34.03	26.480	156.0	0.468			210	8.37	34.08	26.517	152.4	0.486
210	8.35	34.07	26.513	152.9	0.483			220	8.25	34.11	26.559	148.5	0.502
220	8.28	34.09	26.539	150.4	0.499			230	8.11	34.12	26.588	145.7	0.517
230	8.01	34.06	26.556	148.8	0.514			240	7.93	34.12	26.615	143.2	0.532
240	8.06	34.10	26.580	146.5	0.529			252	7.84	34.11	26.620	142.7	0.549
250	8.07	34.14	26.610	143.7	0.544			260	7.83	34.11	26.622	142.5	0.561
260	8.10	34.16	26.621	142.6	0.559			272	7.78	34.13	26.645	140.4	0.579
270	8.07	34.18	26.641	140.7	0.574			280	7.72	34.14	26.661	138.8	0.590
280	7.76	34.18	26.687	136.4	0.588			290	7.67	34.13	26.661	138.8	0.605
290	7.58	34.14	26.682	136.9	0.602			300	7.69	34.15	26.674	137.6	0.619
300	7.56	34.15	26.692	135.8	0.616			310	7.69	34.16	26.681	136.9	0.633
310	7.52	34.15	26.698	135.3	0.630			320	7.78	34.21	26.708	134.4	0.647
320	7.46	34.16	26.715	133.7	0.644			330	7.68	34.22	26.730	132.3	0.661
325	7.40	34.17	26.731	132.2	0.651			340	7.65	34.24	26.750	130.4	0.675
								346	7.53	34.23	26.759	129.5	0.683

STATION	STD	7	RV ELLEN B. SCRIPPS				CRUISE 7611				STATION	STD	8
LATITUDE	LONGITUDE	MO/DAY/YR	START TIME	BOTTOM	LATITUDE	LONGITUDE	MO/DAY/YR	START TIME	BOTTOM				
		11/11/76	2053	GMT			11/11/76	2136	GMT				
WIND	SPEED	WAVES	WEA	BAROMETER	DRY	WET	CLOUDS	WIND	SPEED	WAVES	WEA	BAROMETER	DRY
Z	T	S	SIGT	DT	DD			Z	T	S	SIGT	DT	DD
1	19.93	33.85	23.925	399.1	0.004			1	19.92	33.82	23.905	401.0	0.004
10	19.93	33.86	23.933	398.4	0.040			10	19.93	33.86	23.933	398.4	0.040
21	19.93	33.86	23.933	398.4	0.084			16	19.92	33.86	23.935	398.1	0.064
30	18.39	33.99	24.424	351.5	0.118			20	19.91	33.87	23.945	397.1	0.080
32	17.87	33.90	24.483	345.9	0.125			30	18.41	33.94	24.381	355.7	0.118
34	17.24	33.86	24.604	334.4	0.131			32	17.93	34.02	24.560	338.6	0.125
38	15.67	34.08	25.135	283.8	0.144			38	16.77	33.82	24.684	326.8	0.145
39	14.78	33.94	25.223	275.4	0.147			40	16.03	33.84	24.870	309.1	0.151
41	14.40	33.82	25.212	276.5	0.152			44	14.79	33.77	25.090	288.1	0.163
43	13.83	33.80	25.316	266.6	0.158			45	13.83	33.62	25.178	279.8	0.166
47	12.91	33.67	25.402	258.4	0.168			48	13.24	33.54	25.236	274.2	0.174
50	12.56	33.64	25.447	254.1	0.176			51	12.95	33.59	25.332	265.0	0.182
54	12.33	33.62	25.476	251.4	0.186			60	12.25	33.64	25.507	248.4	0.205
60	11.77	33.65	25.606	239.1	0.201			72	11.10	33.64	25.720	228.1	0.234
71	10.66	33.63	25.791	221.4	0.226			80	10.64	33.59	25.763	224.1	0.252
80	10.53	33.67	25.845	216.3	0.246			90	10.42	33.70	25.887	212.3	0.274
90	10.31	33.73	25.930	208.3	0.268			100	10.12	33.75	25.977	203.7	0.295
100	10.07	33.77	26.002	201.4	0.288			110	9.92	33.76	26.019	199.8	0.316
110	9.78	33.81	26.081	193.8	0.308			120	9.68	33.82	26.106	191.5	0.336
121	9.65	33.79	26.088	193.3	0.330			130	9.52	33.83	26.140	188.3	0.355
130	9.50	33.87	26.175	185.0	0.347			141	9.14	33.87	26.233	179.4	0.375
141	9.18	33.91	26.258	177.1	0.367			150	9.04	33.88	26.257	177.2	0.392
150	9.00	33.90	26.279	175.1	0.383			160	8.88	33.94	26.329	170.3	0.409
162	8.89	33.97	26.351	168.3	0.404			172	8.78	33.99	26.384	165.1	0.430
170	8.67	34.01	26.416	162.0	0.418			179	8.72	34.00	26.401	163.5	0.442
181	8.64	33.97	26.390	164.5	0.436			190	8.49	34.06	26.483	155.7	0.460
190	8.56	34.04	26.457	158.2	0.451			201	8.47	34.06	26.486	155.4	0.477
200	8.41	34.07	26.504	153.8	0.467			210	8.45	34.10	26.521	152.1	0.491
210	8.38	34.09	26.524	151.8	0.483			219	8.30	34.14	26.575	147.0	0.505
219	8.24	34.10	26.553	149.1	0.496			231	7.99	34.12	26.606	144.1	0.523
230	8.09	34.11	26.583	146.2	0.513			240	7.83	34.09	26.606	144.0	0.536
240	7.96	34.12	26.610	143.6	0.528			250	7.90	34.09	26.596	145.0	0.551
250	7.87	34.12	26.624	142.3	0.543			261	7.88	34.13	26.630	141.8	0.567
260	7.74	34.09	26.619	142.8	0.557			269	7.95	34.14	26.628	142.0	0.579
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