NP9402. Additional Information

CTD/Rosette Data Acquisition

Vertical profiles of temperature, conductivity and oxygen were made at 157 locations, most to within ~10 m of the sea floor. A SeaBird 911^+ system with Seasoft 4.035 data acquisition software was used for the CTD measurements, with seawater pumped past the conductivity cell. The data were acquired at a rate of 24 Hz, with pressure, temperature and conductivity measured as 3 frequencies, and oxygen current, oxygen temperature, and altimeter measured as 3 external voltages. A bottom contact altimeter was mounted on the instrument frame after the failure of a pinger deployed in that mode, and provided distance above bottom at closest approach.

Twenty-four 10-liter ‘Niskin’ bottles were mounted on a General Oceanics rosette above the CTD for water sampling. Depending on water column characteristics, up to 24 depths were sampled during the CTD ascent (upcast) for salinity, dissolved oxygen, nutrients, carbon dioxide, chlorofluorocarbons, helium and oxygen isotopes and tritium. Substantial problems with two different types of Niskin bottles necessitated continual repair and monitoring to ensure sample integrity. As many stations were occupied over the continental shelf, two or more bottles were often closed at the same depth, providing a back-up or additional water for geochemical sampling.

Table 1. NP9402 CTD stations. From left to right, read: downcast number, GMT date and time, station coordinates, bottom depth and closest approach to the sea floor (HT in meters), surface pressure (in mbar), true wind direction and speed (m/s) and air temperature (°C). Entries of -999 under HT indicate there was no close approach to the sea floor.

SHCRUS	STN	YR/MO/DA	GTIME	LATITUDE	LONGITUDE	DPTH	HT	BARO	WND	WNS	AIRTM
NP9402	001D	94/02/14	10:48	-77.171	167.785	899	10	981	45	10	-4.6
NP9402	002D	94/02/16	02:23	-78.017	-160.050	656	20	975	138	10	-12.7
NP9402	003D	94/02/16	07:08	-77.635	-159.299	275	9	980	64	11	-4.4
NP9402	004D	94/02/16	10:23	-77.355	-158.735	834	0	981	42	14	-5.3
NP9402	005D	94/02/16	15:08	-76.866	-157.826	275	7	982	94	8	-6.5
NP9402	006D	94/02/16	19:08	-76.461	-157.064	367	10	983	299	5	-3.8
NP9402	007D	94/02/16	21:53	-76.429	-157.029	967	10	984	270	3	-2.9
NP9402	008D	94/02/17	00:58	-76.405	-157.037	1685	10	985	298	3	-2.6
NP9402	009D	94/02/17	06:03	-76.008	-156.260	3238	-999	986	220	7	-3.8
NP9402	010D	94/02/17	21:33	-76.812	-153.502	1201	15	988	227	3	-11.9
NP9402	011D	94/02/18	11:21	-76.315	-150.015	197	10	989	164	9	-17.4
NP9402	012D	94/02/18	12:36	-76.221	-149.981	986	20	988	165	9	-11.4
NP9402	013D	94/02/18	16:55	-75.935	-149.981	228	7	985	172	8	-4.9
NP9402	014D	94/02/18	19:10	-75.662	-150.033	905	10	983	204	5	-3.6
NP9402	015D	94/02/18	21:55	-75.688	-149.955	299	10	982	213	1	-4.8
NP9402	016D	94/02/19	00:11	-75.516	-149.936	2933	10	980	181	2	-5.2
NP9402	017D	94/02/19	07:41	-75.008	-150.061	3717	10	976	50	3	-11.4
NP9402	018D	94/02/20	00:25	-73.992	-150.031	4029	11	967	94	12	-3.6
NP9402	019D	94/02/21	00:26	-73.473	-139.987	3863	4	971	79	12	-3.9

NP9402	020D	94/02/21	07:11	-73.840	-140.062	2294	6	972	99	8	-3.9
NP9402	021D	94/02/21	13:10	-74.118	-139.341	1732	0	974	86	7	-4.1
NP9402	022D	94/02/21	16:55	-74.139	-139.373	1029	4	975	86	8	-3.3
NP9402	023D	94/02/21	19:41	-74.165	-139.369	392	7	976	92	8	-3.9
NP9402	024D	94/02/22	02:25	-74.526	-138.532	919	10	979	82	12	-3.6
NP9402	025D	94/02/22	05:25	-74.780	-138.413	668	10	980	62	12	-4.6
NP9402	026D	94/02/22	12:25	-74.480	-137.184	1110	0	982	94	16	-5.5
NP9402	027D	94/02/22	22:40	-74.473	-133.851	962	10	985	110	10	-4.5
NP9402	028D	94/02/23	03:10	-74.344	-132.010	198	10	986	92	14	-3.4
NP9402	029D	94/02/23	07:56	-74.247	-130.013	844	20	988	50	19	-5.7
NP9402	030D	94/02/23	11:25	-74.214	-129.047	1012	10	989	109	10	-5.9
NP9402	031D	94/02/23	14:41	-74.067	-128.001	679	10	989	122	15	-9.0
NP9402	032D	94/02/23	22:25	-73.123	-127.732	380	10	990	68	11	-5.2
NP9402	033D	94/02/24	00:55	-72.896	-127.673	2005	10	990	100	10	-6.1
NP9402	034D	94/02/24	03:11	-72.960	-127.647	601	10	990	91	7	-5.1
NP9402	035D	94/02/24	04:26	-72.943	-127.641	904	10	990	84	6	-5.6
NP9402	036D	94/02/24	10:11	-72.625	-127.435	2462	10	990	193	2	-7.2
NP9402	037D	94/02/24	18:25	-72.158	-127.555	3212	10	989	185	6	-4.4
NP9402	038D	94/02/25	02:55	-71.250	-127.208	3579	10	988	231	6	-3.1
NP9402	039D	94/02/25	10:10	-70.449	-126.984	3732	10	988	232	9	-6.5
NP9402	040D	94/02/25	17:41	-69.709	-126.946	1386	10	988	240	5	-2.9
NP9402	041D	94/02/26	01:11	-68.899	-126.624	3843	10	986	318	11	0.0
NP9402	042D	94/02/26	08:10	-68.151	-126.445	4011	7	985	263	12	0.1
NP9402	043D	94/02/26	14:56	-67.398	-126.282	4354	10	988	254	12	0.7
NP9402	044D	94/02/27	23:41	-72.554	-123.947	1293	10	973	68	12	-1.2
NP9402	045D	94/02/28	02:25	-72.668	-123.692	454	10	972	88	12	-2.5
NP9402	046D	94/03/01	04:56	-73.927	-118.665	1482	10	968	138	15	-7.3
NP9402	047D	94/03/01	09:55	-74.004	-117.894	1300	8	970	232	14	-8.5
NP9402	048D	94/03/01	13:56	-73.850	-116.649	1106	10	973	251	10	-5.6
NP9402	049D	94/03/01	18:10	-73.992	-115.794	1249	10	976	307	8	-5.1
NP9402	050D	94/03/01	22:26	-73.565	-115.001	908	8	980	306	4	-4.3
NP9402	051D	94/03/02	03:10	-73.024	-113.899	517	10	982	131	4	-5.9
NP9402	052D	94/03/02	11:40	-72.627	-113.201	423	10	980	155	14	-5.2
NP9402	053D	94/03/02	17:56	-72.293	-112.751	498	10	978	164	9	-3.0
NP9402	054D	94/03/03	02:55	-73.000	-111.834	385	10	980	216	4	-2.0
NP9402	055D	94/03/03	09:10	-73.357	-110.856	296	10	980	300	7	-3.9
NP9402	056D	94/03/03	16:56	-73.990	-109.570	473	10	978	296	6	-4.4
NP9402	057D	94/03/04	04:26	-73.965	-109.111	885	10	976	338	2	-11.4
NP9402	058D	94/03/04	15:55	-73.748	-112.244	647	10	977	204	6	-4.9
NP9402	059D	94/03/05	00:25	-73.450	-116.751	331	10	982	162	4	-3.0
NP9402	060D	94/03/05	04:56	-73.332	-118.584	480	10	985	226	14	-6.5
NP9402	061D	94/03/05	11:40	-72.662	-118.633	471	10	990	227	11	-9.3
NP9402	062D	94/03/05	20:10	-71.968	-118.497	593	10	995	223	7	-7.7
NP9402	063D	94/03/05	22:56	-71.892	-118.520	941	10	994	280	5	-7.0
NP9402	064D	94/03/06	02:55	-71.701	-118.450	1438	10	992	258	6	-3.6
NP9402	065D	94/03/06	07:10	-71.467	-118.593	2003	10	988	305	6	-1.2
NP9402	066D	94/03/07	02:26	-71.658	-113.291	601	10	980	263	4	-2.1
NP9402	067D	94/03/07	07:56	-71.051	-112.484	2602	10	983	265	12	-0.2
NP9402	068D	94/03/07	13:56	-70.348	-111.586	3306	10	984	284	13	0.0
NP9402	069D	94/03/07	20:10	-69.696	-110.790	3663	10	987	272	12	0.5
NP9402	070D	94/03/08	03:11	-69.002	-110.118	3746	15	988	274	12	0.1
NP9402	071D	94/03/08	10:26	-68.321	-110.092	3811	-999	990	262	17	1.3
NP9402	072D	94/03/08	13:25	-67.983	-110.012	3954	10	991	276	15	1.0
NP9402	073D	94/03/08	19:26	-67.506	-109.487	3983	-999	990	281	16	1.0

NP9402	074D	94/03/08	23:47	-66.999	-108.543	4569	15	991	270	15	1.3
NP9402	075D	94/03/09	14:55	-66.997	-103.464	4717	10	987	236	19	0.1
NP9402	076D	94/03/09	22:37	-67.496	-103.230	4627	15	990	241	18	-1.4
NP9402	077D	94/03/10	06:26	-68.001	-102.990	4486	0	990	246	14	-1.4
NP9402	078D	94/03/10	12:40	-68.500	-102.741	4234	10	983	312	16	-0.9
NP9402	079D	94/03/10	18:26	-69.001	-102.497	4023	15	980	270	14	0.1
NP9402	080D	94/03/11	02:04	-69.501	-102.249	4060	10	978	285	13	-0.4
NP9402	081D	94/03/11	13:41	-69.982	-102.065	3978	10	977	289	10	-1.1
NP9402	082D	94/03/11	20:37	-70.451	-101.736	3350	10	975	280	7	0.0
NP9402	083D	94/03/12	00:07	-70.423	-101.683	3415	-999	977	271	5	-1.8
NP9402	084D	94/03/12	05:41	-70.884	-101.479	2414	10	977	298	8	-5.8
NP9402	085D	94/03/12	10:11	-71.075	-101.518	1876	10	977	250	4	-8.2
NP9402	086D	94/03/12	12:25	-71.089	-101.488	1509	10	976	3	1	-7.6
NP9402	087D	94/03/12	14:55	-71.115	-101.474	935	10	975	82	4	-8.6
NP9402	088D	94/03/12	18:10	-71.207	-101.556	538	10	974	84	4	-5.7
NP9402	089D	94/03/12	22:26	-71.548	-101.770	428	10	971	98	11	-5.4
NP9402	090D	94/03/13	05:55	-72.103	-103.188	281	10	973	144	5	-8.6
NP9402	091D	94/03/13	12:10	-72.565	-103.165	665	10	973	120	15	-11.5
NP9402	092D	94/03/14	11:39	-75.061	-101.848	971	10	979	135	9	-10.0
NP9402	093D	94/03/14	16:25	-74.904	-101.474	826	10	981	103	5	-7.9
NP9402	094D	94/03/14	19:40	-74.741	-101.365	551	10	982	11	6	-5.7
NP9402	095D	94/03/15	00:48	-74.545	-103.181	1101	10	982	4	6	-8.8
NP9402	096D	94/03/15	13:25	-73.385	-103.118	948	10	972	318	11	-2.9
NP9402	097D	94/03/17	00:58	-70.218	-99.650	4003	-999	990	360	13	0.3
NP9402	098D	94/03/17	05:13	-70.244	-98.014	4064	-999	990	350	14	1.0
NP9402	099D	94/03/17	10:43	-69.760	-96.339	4325	10	992	336	16	1.3
NP9402	100D	94/03/17	18:13	-70.181	-95.535	2986	15	993	330	10	-0.3
NP9402	101D	94/03/17	21:54	-70.257	-95.332	1900	15	994	327	9	-0.2
NP9402	102D	94/03/18	01:58	-70.454	-95.054	920	10	993	331	9	0.2
NP9402	103D	94/03/18	04:43	-70.601	-94.916	539	10	992	329	11	0.5
NP9402	104D	94/03/18	12:28	-71.010	-94.001	443	10	990	337	14	0.4
NP9402	105D	94/03/18	19:07	-70.590	-93.621	1043	10	989	336	12	0.2
NP9402	106D	94/03/18	22:28	-70.526	-93.447	1899	10	987	333	13	-0.2
NP9402	107D	94/03/19	01:13	-70.401	-93.314	2964	10	986	334	13	0.4
NP9402	108D	94/03/19	08:43	-69.764	-92.837	3690	10	987	327	11	0.7
NP9402	109D	94/03/19	14:58	-69.167	-92.334	4236	10	989	324	9	0.6
NP9402	110D	94/03/19	21:43	-68.984	-90.516	1638	15	990	43	5	-0.5
NP9402	111D	94/03/20	01:13	-68.823	-89.716	3539	-999	990	83	5	-0.7
NP9402	112D	94/03/20	04:28	-68.953	-88.979	3604	-999	990	115	3	-0.4
NP9402	113D	94/03/20	07:28	-68.866	-88.033	3487	-999	989	112	4	-0.5
NP9402	114D	94/03/20	13:43	-69.484	-87.851	2926	-999	990	178	4	-1.0
NP9402	115D	94/03/20	18:21	-69.939	-87.724	1959	-999	990	123	3	-1.0
NP9402	116D	94/03/20	22:01	-70.268	-87.581	1228	10	989	68	2	-1.4
NP9402	117D	94/03/21	01:28	-70.517	-87.071	663	10	989	341	2	-2.1
NP9402	118D	94/03/21	09:05	-71.001	-85.992	566	10	987	339	5	-3.2
NP9402	119D	94/03/21	16:57	-71.518	-85.319	491	10	986	8	7	-1.7
NP9402	120D	94/03/21	23:28	-72.189	-85.734	730	15	985	266	5	-5.4
NP9402	121D	94/03/22	09:08	-72.504	-82.982	712	10	981	268	4	-4.7
NP9402	122D	94/03/22	16:08	-72.498	-81.019	862	-999	979	178	1	-4.0
NP9402	123D	94/03/23	07:08	-72.170	-79.048	429	-999	969	32	12	-2.0
NP9402	124D	94/03/23	13:38	-72.168	-76.741	691	10	971	354	12	-0.5
NP9402	125D	94/03/23	18:53	-72.032	-75.234	471	10	976	344	9	-0.6
NP9402	126D	94/03/24	02:08	-72.231	-73.485	534	15	980	11	6	-1.7
NP9402	127D	94/03/24	06:53	-72.684	-72.380	877	10	982	3	10	-1.0

NP9402	128D	94/03/24	09:32	-72.849	-72.481	713	10	983	33	7	-2.2
NP9402	129D	94/03/24	11:53	-73.050	-72.398	608	10	983	37	5	-2.5
NP9402	130D	94/03/24	15:53	-73.104	-73.376	412	10	983	43	6	-1.5
NP9402	131D	94/03/24	20:08	-72.989	-74.000	1128	10	983	27	8	-2.4
NP9402	132D	94/03/25	19:53	-71.250	-76.984	619	10	982	84	2	-4.0
NP9402	133D	94/03/26	04:08	-70.633	-77.669	716	10	982	225	7	-4.8
NP9402	134D	94/03/26	10:38	-70.000	-78.333	398	10	983	216	6	-4.8
NP9402	135D	94/03/26	14:08	-69.665	-78.995	584	10	984	208	7	-5.3
NP9402	136D	94/03/26	21:23	-69.289	-79.446	718	10	989	194	9	-3.2
NP9402	137D	94/03/26	23:38	-69.096	-79.220	1486	10	990	194	8	-5.5
NP9402	138D	94/03/27	02:08	-68.953	-79.033	2462	10	992	207	8	-4.7
NP9402	139D	94/03/27	06:53	-68.499	-78.492	3349	10	994	226	5	-4.8
NP9402	140D	94/03/27	12:08	-67.999	-78.000	3878	10	996	244	4	-4.3
NP9402	141D	94/03/28	00:53	-67.502	-77.497	3308	10	993	10	14	-0.4
NP9402	142D	94/03/28	06:23	-67.002	-77.030	3734	10	993	14	14	0.5
NP9402	143D	94/03/28	13:38	-67.712	-76.288	2897	10	994	344	8	0.5
NP9402	144D	94/03/28	18:32	-68.137	-75.414	2639	10	994	344	6	0.5
NP9402	145D	94/03/28	22:58	-68.205	-75.273	1709	10	995	345	6	0.1
NP9402	146D	94/03/29	01:08	-68.245	-75.190	396	10	995	348	3	0.0
NP9402	147D	94/03/29	04:53	-68.554	-74.506	483	10	996	24	5	-0.7
NP9402	148D	94/03/29	23:23	-68.272	-71.439	654	10	1002	94	7	-1.9
NP9402	149D	94/03/30	04:28	-68.541	-70.038	1394	10	1003	131	8	-2.0
NP9402	150D	94/03/30	17:23	-69.717	-69.257	633	10	1004	153	0	-7.8
NP9402	151D	94/03/30	19:27	-69.715	-69.189	847	10	1004	65	0	-6.3
NP9402	152D	94/03/30	21:34	-69.635	-68.973	858	10	1004	9	2	-2.6
NP9402	153D	94/03/31	00:38	-69.570	-68.805	473	10	1004	9	0	-3.2
NP9402	154D	94/03/31	03:23	-69.623	-68.883	1010	10	1004	320	3	-2.7
NP9402	155D	94/03/31	05:23	-69.665	-69.057	696	10	1004	341	5	-2.7
NP9402	156D	94/03/31	12:08	-68.883	-69.672	918	10	1006	135	5	-2.2
NP9402	157D	94/03/31	15:38	-68.702	-69.833	605	10	1006	111	6	-3.3

CTD sensor calibrations and data processing

CTD data were processed using Seasoft version 4.211, following standard procedures (SeaBird Electronics 1995). Conductivity was lagged relative to pressure by 0.04 seconds to match the temperature response, and the oxygen current and oxygen temperature were advanced by 3 seconds relative to pressure. Problems with the cable and winch caused frequent spikes, so the files were scanned twice, removing data beyond 2 and 5 standard deviations in 100-point segments. The data were corrected for cell thermal mass effects ($\alpha = 0.03$; $1/\beta = 9$), filtered with a median filter of 24 scans and edited to remove pressure reversals due to ship roll or CTD descent during stops for bottle closure (trip). Data obtained during both downcast (descent) and upcast were processed and retained, with bottle depth files generated from data averaged over 3 seconds around bottle trip time. Where software confirmation was not obtained for a bottle trip, information was substituted from a paired bottle, if available, or from a comparison of water sample salinity and CTD salinity at bottle trip time.

The temperature, conductivity, pressure and oxygen sensors were calibrated before and after the cruise by Sea-Bird Electronics, and corrections were applied to the data based on those calibrations. During the cruise the CTD conductivity data drifted toward slightly lower values, and small offset and slope corrections brought the calculated CTD salinities in line with the rosette measurements. Temperatures were corrected by applying the post-cruise calibration coefficients and a linearly interpolated offset with time. Pressure measurements were adjusted by applying a slope and an offset. After those corrections, we obtained a mean rosette-CTD salinity difference of 0.00057 (downcast) and 0.00054 (upcast), with standard deviations of 0.0027 and 0.0024, for all data at pressures greater than 500 dbar.

After pressure, temperature and conductivity corrections had been applied, the CTD oxygen data were processed with post-cruise calibration coefficients. Batches of down and up profiles, aggregated by similar residual differences between the CTD and water sample oxygen values, were further adjusted toward the bottle data, using polynomial fitting procedures. The plots in this report show that substantial offsets remain between rosette and CTD oxygen on some stations, particularly near the oxygen minimum where CTD values tend to be too low. Shallow CTD downcast oxygen values are also typically lower than rosette bottle data, in spite of the equilibration time allowed by cycling the instrument to and from 100 m at the beginning of each station. Nevertheless, the continuous profiles often reveal structure that is missed by the discrete samples, along with the occasional titration outlier. Average differences of 0.012 and 0.016 ml/l for downcast and upcast were obtained between all rosette bottle oxygen and corrected CTD oxygens below 500 dbar.

The SeaBird CTD equipment was generally reliable, but one conductivity sensor displayed an odd sinusoidal component during CTD descent at pressures greater than 1000 dbar. The maximum amplitude of the anomaly was 0.001 in salinity and the mean was not offset from the upcast salinity. This unresolved problem might have been caused by an improperly grounded winch and/or a poorly insulated sensor (SeaBird, p.c., 1995). The upper few meters of most downcasts were removed during processing, but some stations contain shallower upcast data. After averaging into 1 dbar bins, UNESCO (1981, 1983) algorithms were applied to compute potential temperature, salinity and density.

Water sample analyses

Salinity

In order to monitor performance of the CTD conductivity sensor and confirm bottle trip depths, 1222 salinity samples were processed on Guildline 8400 and 8400A Autosal salinometers, standardized with IAPSO Standard Seawater batch P122. Salinity samples were drawn into 120 ml bottles and processed after sample temperature equilibration. Attempts were made to keep the ship's laboratory temperature 1-3 degrees below the Autosal bath temperature (21 and 24°C). The actual range was larger, but was minimized by using a water bath for the sample bottles from some stations. Salinity was calculated according to the equations of the Practical Salinity Scale of 1978 (UNESCO, 1981), using a minimum of two conductivity ratio determinations. Thirty-two replicate sample pairs (drawn from the same rosette bottle) showed a mean difference and standard deviation of 0.0003 and 0.0017 respectively. One hundred thirteen duplicate samples (drawn from different rosette bottles closed at the same nominal depth) showed a mean salinity difference of 0.0014.

Dissolved oxygen

Dissolved oxygen measurements were made with an automatic titration system developed and constructed at the Scripps Institution of Oceanography. Dissolved oxygen samples were drawn first, or immediately after chlorofluorocarbon and/or helium/tritium samples. Analysis procedures followed the WOCE operations manual (Culberson, 1991), with the exceptions that higher concentrations of potassium iodate (0.012-0.013N) and thiosulfate (0.22N) were used to accommodate the relatively high dissolved oxygen content, and sample temperature was estimated to be 0.5-1.0°C above the CTD recording at bottle closure depth. The data were corrected for blank and thiosulfate drift. Fifty-eight oxygen replicate samples differed in average by 0.0057 ml/l. Duplicate oxygen pairs (107) gave a mean difference of 0.008 ml/l.

Nutrients

Phosphate, nitrate (+nitrite) and silicate analyses were made on ~1600 samples, each processed in replicate on the ship's Alpkem Rapid Flow Analyzer (RFA-2). The phosphate analysis procedure was a modification of Bernhardt and Wilhelms (1967). The nitrate and silicate procedures followed or modified techniques in Armstrong et al. (1967). With few exceptions, the RFA software was used for calculations, including baseline corrections, replicate averages and the calibration to working standards. Additional adjustments to the output were necessary, in part to account for differences between distilled water available aboard ship and coastal California seawater used in the preparation of standards. Deficiencies in the unmodified RFA hardware included small transmission and mixing coils and small sample cups, which can magnify the effects of contamination and evaporation. In addition, temperature control of the laboratory where nutrients were analyzed was marginal, as noted above.

The resulting nutrient data set is of lower quality than desired. Attempts to determine systematic corrections for the *Palmer* nutrients by using 1992 measurements along the WOCE S4 line (67°S) as a deep-water reference standard were not successful, but see Rubin et al. (1997). Phosphate results are noisier than nitrate. On individual processing runs, silicate replicates typically differed by 0.5-1.0 μm/liter. Near-surface phosphate and nitrate values are lower than measured during the WOCE S4 cruise along 67°S, and silicate values are higher (not shown). This probably results from the more southerly locations of most NP9402 stations, where upwelling and biological productivity may be higher. Nutrient values have been dropped from several stations where large (>2 sigma) anomalies were apparent in the deep water. The NP9402 statistics compare favorably with the WOCE data taken during the same season two years earlier (Table 2). However, the *Palmer* nutrient data are relatively noisy and must be used with caution.

Table 2. WOCE S4 and NP9402 nutrient statistics for pressures deeper than 1000 dbar. Columns indicate number of measurements, range of values, mean and standard deviation. Units are μm/kg. WOCE S4 nutrient data courtesy of J. Swift.

	#	Min.	Max.	Mean	Std. Dev.
WOCE S4					
SIO3	765	87.5	147.9	123.3	13.47
NO3	768	30.6	32.8	31.7	0.43
PO4	767	2.10	2.28	2.22	0.031
NP9402					
SIO3	305	87.1	148.1	124.6	13.09
NO3	307	30.4	33.9	32.2	0.50
PO4	292	1.88	2.42	2.18	0.084

Other chemical analyses

$\delta^{18}O$ values for the oxygen isotope samples that have been processed to date. That work was done at Lamont to a routinely achievable precision of 0.03 $^{o}/_{oo}$ referenced to Standard Mean Ocean Water and using methods detailed in Fairbanks (1982). The shipboard processing of water samples for carbon dioxide content are described in Rubin et al (1997). Here we have simply duplicated their listings for pCO_2 (referenced to 4°C) and TCO_2. At selected stations, water samples and bottom sediments were collected and analyzed for particulate organic carbon (POC) and the ^{13}C content of POC at Indiana University (Hayes and McTaggart 1994; McTaggart et al. 1995). More than 1200 seawater samples were drawn and sealed in glass and metal containers for analyses of chlorofluorocarbon, helium and tritium content in the Smethie and Schlosser laboratories at Lamont.

Other investigations

A variety of other observations were made during cruise NP9402, by investigators studying seals, seabirds, glacial ice, bathymetry and magnetics. Some of this work is outlined in volume 29(5) of the Antarctic Journal of the U.S. (1994). Portions of these observations and the ocean station data have been reported to the National Geophysical and Oceanographic Data Centers.

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