SOLUBILITY DATA SERIES

Volume 7

OXYGEN AND OZONE

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COMPONENTS:

(1) Oxygen; O_2; [7782-44-7]

(2) Seawater

EVALUATOR:

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CRITICAL EVALUATION:

Many studies have been made of oxygen solubility in seawater (1-16). Unfortunately, among the early measurements (1-8) there exist serious discrepancies of as much as 4 per cent. These data often cover narrow salinity and temperature ranges, are less precise, and are sometimes subject to large systematic errors caused mainly by the loss of iodine and by the addition of oxygen from reagents (9-16). As a result, these early measurements will not be analyzed.

More recently, Carpenter (11) has made extremely careful measurements of oxygen solubility in pure water and seawater using the Winkler titration method. Subsequently, Green (10, 13) and Murray and Riley (16) also published oxygen solubility data in pure water and seawater using a similar method. The data of Carpenter and of Murray and Riley agree closely, the average difference being less than 0.01 ml/l. Green's data are of good quality but are approximately 0.1 ml/l higher than those of Carpenter and Murray and Riley in the low temperature range. Because of the excellent agreement between these two sets of data and a possible systematic error in Green's measurements (11), his data are listed in this study for comparison purposes only and are excluded from further analysis. Murray and Riley (16) also measured oxygen solubility in pure and saline waters using gasometric method. However, they neglected to correct their gasometric data for the gas dissolution effect on the volume of the aqueous phase (17). Because of this and because there are few gasometric data, these values are not included in the analysis, although they are listed in this study.

The determined values of oxygen solubility of Carpenter (11) and Murray and Riley (16) are all reported as the volume of oxygen per unit volume of water (ml/l). However, the methods of smoothing and representing the results are quite different. The results are also difficult to use because they have been tabulated, but not reported, in the form of equations. Weiss recognized this problem (17) and suggested the use of the following equation to represent the gas solubility data:

$$\ln C = A_1 + A_2(100/(T/K)) + A_3 \ln(T/100K) + A_4(T/100K) + S[B_1 + B_2(T/100K) + B_3(T/100K)^2] \ldots \quad (1)$$

where C may be either the solubility in ml (STP)/l or in ml (STP)/kg from water saturated air at a total pressure of one atmosphere, T is the Kelvin temperature, the A's and B's are constants, and S is the salinity in parts per thousand.

The first four terms of eq. (1) are obtained from the integrated form of the Van't Hoff equation (18). The salinity dependence is obtained from the commonly used Setchenow relation although the choice of ST and ST^2 terms seems to be somewhat arbitrary. Further, the S^2 term is not included although Carpenter found that it was needed (11).

Chen and Carpenter (19) have since re-analyzed the data of Carpenter (11) and Murray and Riley (16). The analyses were performed by first using these two sets of data separately and then combined. It was found in all three cases that the ST^2 term is not significant statistically and the precision of the fit improves by approximately 10 per cent after discarding the ST^2 term and replacing the ST term by S/T. The ST term was found to be insignificant while the S^2 term is, when the S/T term is included. This confirms the finding of Carpenter. It was also found that the $1/T^2$ term is not significant for the gas solubility in pure water, contrary to the finding of Benson and Krause (20, 21). The final equation generated from the combined data sets of Carpenter and Murray and Riley is:

continued on following page

COMPONENTS:	EVALUATOR:
(1) Oxygen; O_2; [7782-44-7]	Chen-Tung A. Chen School of Oceanography Oregon State University Corvallis, OR 97331 U.S.A.
(2) Seawater	

CRITICAL EVALUATION:

continued

$$\ln C = -1268.9782 + 36063.19/(T/K) + 220.1832 \ln (T/K) - 0.351299 (T/K) + S(6.229 \times 10^{-3} - 3.5912/(T/K)) + 3.44 \times 10^{-6} S^2 \quad (2)$$

where C is the solubility in ml/l at STP. The standard deviation of eq. (2) is ±0.012 ml/l.

Since the analytical precision of the oxygen determination has improved over the last few years, the concentrations of oxygen in the oceans are more and more frequently reported as ml or μmol per unit mass of seawater. To avoid the tedious work of computing the densities of seawater in order to change the units in routine use, we have also fit the data in the form of ml/kg and μmol/kg (17, 21, 22). The equation presented by Millero, Gonzalez and Ward (23) is used to calculate seawater densities. The best fit equations are as follows:

$$\ln C \text{ (ml/kg)} = -1286.2408 + 36607.82/(T/K) + 223.0650 \ln (T/K) - 0.354587 (T/K) + S(5.954 \times 10^{-3} - 3.7341/(T/K)) + 3.68 \times 10^{-6} S^2 \pm 0.012 \text{ ml/kg} \quad (3)$$

$$\ln C \text{ (μmol/kg)} = -1282.8704 + 36619.96/(T/K) + 223.1396 \ln (T/K) - 0.354707 (T/K) + S(5.957 \times 10^{-3} - 3.7353/(T/K)) + 3.68 \times 10^{-6} S^2 \pm 0.52 \text{ μmol/kg} \quad (4)$$

These equations are valid over the range of 0 to 35.5°C and 0 to 40‰ salinity. The factor of 22393 ml/mol was used to convert the volume of oxygen to moles.

The solubility of oxygen in marine brines has recently been investigated by Kinsman, Boardman and Borcsik (24) at 22 and 50°C up to 144 parts per thousand in chlorinity. The precision of the data probably was not much better than 4 per cent.

The effect of pressure upon the solubility of oxygen in seawater up to 102 atm has been measured by Enns, Scholander and Bradstreet (25). They reported that the equilibrium pressure increase was approximately 14 per cent at 100 atm hydrostatic pressure. They predicted that at 1000 atm the equilibrium partial pressure of oxygen would be increased nearly fourfold.

Carey and Gibson (26) measured the activity of dissolved oxygen based on its rate of reaction with the excited singlet state of pyrene-1-butyric acid and reported that it is not changed by hydrostatic pressures up to 1000 atm. They concluded that the partial pressure of dissolved oxygen will have the same relation to concentration at abyssal depths as at the surface. Carey thought it likely that neither of the above two papers gave the whole story on the pressure effect on oxygen solubility (Carey, personal communication, 1976). More recently, Taylor (27) measured the molar oxygen concentration in an artificial seawater medium in equilibrium with a high pressure oxygen-helium atmosphere. He concluded that at a partial pressure of oxygen of 1 atm or less, its concentration in the aqueous phase was adequately described by Henry's Law at total pressures of up to 600 atm. His work on seawater and pure water (28) seems to substantiate the results of Enns, Scholander and Bradstreet (25). Due to the scarcity of the data that are of satisfactory precision, meaningful equations cannot be derived

continued on following page

COMPONENTS:

(1) Oxygen; O_2; [7782-44-7]

(2) Seawater

EVALUATOR:

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CRITICAL EVALUATION:

continued

to represent the oxygen solubility at high salinities and high pressures. More measurements are clearly in order.

References

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2. Whipple, G. C.; Whipple, M. C. *J. Am. Chem. Soc.* 1911, *33*, 362-5.
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11. Carpenter, J. H. *Limnol. Oceanog.* 1966, *11*, 264-77.
12. Carritt, D. E.; Carpenter, J. H. *J. Mar. Res.* 1966, *24*, 286.
13. Green, E. J.; Carritt, D. E. *J. Mar. Res.* 1967, *25*, 140.
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23. Millero, F. J.; Gonzalez, A.; Ward, G. K. *J. Mar. Res.* 1976, *34*, 61.
24. Kinsman, D. J. J.; Boardman, M.; Borcsik, M. *Symp. Salt, 4th*, 1973, (Pub. 1974), *1*, 325-7.
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26. Carey, F. G.; Gibson, Q. H. *Deep-Sea Res.* 1976, *23*, 1215.
27. Taylor, C. D. *Undersea Biomedical Res.* 1979, *6*, 147-54.
28. Taylor, C. D. *Arch. Biochem. Biophys.* 1978, *191*, 375-84.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Oxygen; O_2; [7782-44-7] (2) Seawater (3) Water; H_2O; [7732-18-5]	Enns, T.; Scholand Bradstreet, E. D *J. Phys. Chem.* 19
VARIABLES: T/K = 274-298 P/MPa (hydrostatic) = 0-10	**PREPARED BY:** Chen-Tung A. Chen

EXPERIMENTAL VALUES:

t/°C	T[a]/K	P^b=0 (0 MPa)	P^b=34 atm (3.45 MPa)	P^b= 68 a (6.89 MP
		Distilled Water		
0.5	273.7	682		
25	298.2	734.5	771	805
25	298.2	781	819	855
25	298.2	359	373	390
25	298.2	443	464	484
		Seawater		
25	298.2	737	775	806

[a] Calculated by compiler.

[b] Hydrostatic pressure.

[c] The values in the table are the oxygen equilibrium pres
mm Hg. The table shows the effect of hydrostatic press
oxygen equilibrium pressure.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF M
Water was gas-extracted before the experiment. Oxygen at the desired initial pressure was dissolved in it at controlled temperature. The equilibrium vessel was shaken for 0.5 to 1 hr during the oxygen uptake. The solution was then transferred to a syringe which has a teflon tubing attached to it. Pressure was then measured by a null point measurement of the pressure developed within the teflon tube.	(1) No details gi ESTIMATED ERROR: REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Oxygen; O_2; [7782-44-7] (2) Seawater	Green, E. J. *Ph.D. thesis, Massachusetts Institute of Technology*, 1965.
VARIABLES: T/K = 274-308 Salinity	PREPARED BY: Chen-Tung A. Chen

EXPERIMENTAL VALUES:

Chlorinity	t/°C	T^a/K	$10^3\alpha$/ cm(STP) cm^{-3} atm^{-1}
0	0.59	273.74	48.633 48.598 48.669 48.661 48.665 48.618
0	5.03	278.18	43.118 42.890 42.932 42.920 42.972 42.857
0	15.09	288.24	34.299 34.228 34.244 34.208 34.153 34.356
0	22.02	295.17	30.061 30.242 30.177 30.059 30.086
0	22.02	295.17	30.066 29.938 29.945 30.026 29.996 29.981 29.913 30.140 30.072 30.131 30.071 30.049 30.074 30.083 29.990 30.092 30.080 30.103 30.156
0	22.05	295.20	30.137 30.090 30.126 30.061 30.118 30.101

continued on following page

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Distilled and seawater were simultaneously saturated with air with two 12-l round bottom long-neck flasks inclined at a 45° angle and arranged to rotate about their axes of symmetry. A thin film of water was drawn over the inside surface of the flask by its rotation. The reagents ($MnCl_2 \cdot 4H_2O$, NaI, NaOH, H_2SO_4) were added to the equilibrated water (after at least 8 hours of rotation) and the thiosulfate titration end point determined by the Amperometric technique using a Keithley microammeter. A modified Winkler method was used.

SOURCE AND PURITY OF MATERIALS:

ESTIMATED ERROR:

$\delta T/K = \pm 0.01$

$\delta Cl‰ < \pm 0.028‰$

$\delta\alpha/\alpha = \pm 0.0027$

REFERENCES:

1. Green, E.J., *Ph.D. thesis Massachusetts Institute of Technology*, 1965.
2. Green, E.J.; Carritt, D.E., *J. Mar. Res.* 1967, 25, 140.

COMPONENTS:	EVALUATOR:
(1) Oxygen; O_2; 7782-44-7 (2) Seawater	Green, E. J. *Ph.D. thesis, Massachusetts Institute of Technology, 1965.*

CRITICAL EVALUATION:

continued

Chlorinity	t/°C	T^a/K	$10^3\alpha$/ cm(STP)$cm^{-3}atm^{-1}$
0	24.92	298.07	28.494 28.549 28.730 28.682 28.670 28.661
0	34.81	307.96	24.086 24.129 24.132 24.181 24.085 24.199
6.349	22.02	295.17	28.099 28.139 28.165 28.262
12.412	22.02	295.17	26.324 26.263 26.214 26.269 26.263 26.245
17.419	5.03	278.18	34.860 34.930 34.890 34.695 34.723 34.821
17.464	0.59	273.74	39.022 39.092 39.051 39.099 39.079 39.132
17.487	22.02	295.17	24.961 25.108 25.091
17.551	15.09	288.24	28.177 28.161 28.206 28.162 28.203 28.067
17.562	34.81	307.96	20.172 20.197 20.194 20.231 20.200 20.246
17.632	24.92	298.07	23.652 23.865 23.901 23.905 23.856 23.770
24.339	22.02	295.20	23.323 23.375 23.378 23.391
30.804	22.02	295.20	21.965 21.912 21.874 21.825 21.930 21.855

[a] Calculated by compiler.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Oxygen; O_2; [7782-44-7]	Carpenter, J. H.
(2) Seawater	*Limnol. Oceanog.* 1966, *11*, 264-77.
VARIABLES:	**PREPARED BY:**
T/K = 274-309 Chlorinity	Chen-Tung A. Chen

EXPERIMENTAL VALUES:

Chlorinity /‰	t/°C	T^a/K	S^b / (ml/liter)	Chlorinity /‰	t/°C	T^a/K	S^b/ (ml/liter)
0.0	0.48	273.63	10.120	0.0	12.38	285.53	7.469
	0.52	273.67	10.088		12.40	285.55	7.476
	0.64	273.79	10.062		12.40	285.55	7.485
	5.02	278.17	8.898		12.41	285.56	7.465
	5.07	275.22	8.903		12.41	285.56	7.473
	5.08	275.23	8.898		12.43	285.58	7.462
	5.10	275.25	8.890		14.55	287.70	7.139
	5.11	275.26	8.875		14.72	287.87	7.116
	5.13	275.28	8.884		14.97	288.12	7.078
	5.18	278.33	8.862		14.99	288.14	7.079
	5.21	278.36	8.858		15.12	288.27	7.054
	9.85	283.00	7.894		15.14	288.29	7.057
	9.86	283.01	7.897		20.08	293.23	6.340
	9.89	283.04	7.899		20.10	293.25	6.344
	9.94	283.09	7.884		25.10	298.25	5.761
	10.10	283.25	7.863		25.35	298.50	5.734
	10.22	283.37	7.839		25.36	298.51	5.742
	11.68	284.83	7.584		29.80	302.95	5.301
	12.04	285.19	7.531		29.81	302.96	5.308
	12.36	285.51	7.483		34.76	307.91	4.867
	12.37	285.52	7.491		34.82	307.97	4.868

continued on following page

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The sample was contained in a plexiglass (perspex) box which was placed on a frame that could be rocked to mix air and liquid. The equilibrated water was transferred to a pyrex bottle and the reagents ($MnCL_2 \cdot 4H_2O$, NaI, NaOH, H_2SO_4) added. The resulting solution was then titrated with thiosulfate solution with the iodine endpoint detected by a Beckman DU spectrophotometer at 320 and 350 μm. The method was a modified Winkler method with a weight photometric titration. See references.

SOURCE AND PURITY OF MATERIALS:

(1) From air collected in the country 32 km west of Baltimore, MD. 20.94% oxygen.

ESTIMATED ERROR:

δT/K = ±0.01
δS/S = ±0.001, author's estimate

REFERENCES:

(1) Carpenter, J. H. *Limnol. Oceanog.* 1965, *10*, 135.
(2) Carpenter, J. H. *Limnol. Oceanog.* 1966, *11*, 264.
(3) Carritt, D. E.; Carpenter, J. H. *J. Mar. Res.* 1966, *24*, 286.

COMPONENTS:	EVALUATOR:
(1) Oxygen; O_2; [7782-44-7] (2) Seawater	Carpenter, J. H. *Limnol. Oceanog.* 1966, *11*, 264-77.

EXPERIMENTAL VALUES: continued

Chlorinity /‰	t/°C	T^a/K	s^b / (ml/liter)	Chlorinity /‰	t/°C	T^a/K	s^b / (ml/liter)
	35.43	308.58	4.597		0.62	273.77	8.331
4.99	35.45	308.60	4.596		0.55	273.70	8.315
	35.45	308.60	4.597		5.39	278.54	7.408
				15.00	5.37	278.52	7.401
	20.08	293.23	6.017		10.16	283.31	6.618
	20.09	293.24	6.017		10.20	283.35	6.613
	25.02	298.17	5.475		14.10	287.25	5.982
5.07	25.05	298.20	5.475		14.97	288.12	5.971
	30.04	303.19	5.008				
	30.09	303.24	4.992		20.15	293.30	5.396
	35.18	308.33	4.592		20.11	293.26	5.393
					25.24	298.39	4.924
	0.48	273.63	9.447		25.27	298.42	4.922
	0.49	273.64	9.443	15.18	29.99	303.14	4.542
	5.28	278.43	8.335		30.01	303.16	4.542
5.17	5.29	278.44	8.336		35.50	308.65	4.162
	10.15	283.30	7.398		35.50	308.65	4.162
	10.19	283.34	7.386		35.50	308.65	4.161
	14.94	288.09	6.663				
	14.95	288.10	6.654		0.41	273.56	7.863
					0.44	273.59	7.856
10.02	35.48	308.63	4.363	20.32	1.09	274.24	7.729
	35.56	308.71	4.361		9.88	283.03	6.292
					35.53	308.68	3.961
	0.60	273.75	8.886		35.58	308.73	3.963
	0.64	273.79	8.851				
	5.30	278.45	7.883		20.18	293.33	5.115
10.13	5.35	278.50	7.873		20.18	293.33	5.117
	10.17	283.32	6.994	20.37	25.23	298.38	4.688
	10.14	283.29	6.993		25.25	298.40	4.685
	15.02	288.17	6.288		29.98	303.13	4.300
					29.99	303.14	4.304
	20.12	293.27	5.666		29.99	303.14	4.304
	20.14	293.29	5.667				
10.49	25.19	298.34	5.154		5.34	278.49	6.919
	25.23	298.38	5.157		5.34	278.49	6.916
	29.97	303.12	4.753	20.88	10.18	283.33	6.196
	29.92	303.07	4.748		10.20	283.35	6.184
					14.97	288.12	5.602
					15.02	288.17	5.590

[a] Calculated by compiler.

[b] Solubilities of oxygen in seawater assuming an oxygen volume of 22,400 ml/mol at STP. Observations were corrected by author to 101.325 kPa total pressure including water vapor and 20.94% oxygen excluding water vapor on the basis of individual gas analyses.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Oxygen; O_2; [7782-44-7] (2) Seawater	Murray, C. N.; Riley, J. P. *Deep-Sea Research*, 1969, *16*, 311-20.
VARIABLES: T/K = 279-301 Salinity	**PREPARED BY:** Chen-Tung A. Chen

EXPERIMENTAL VALUES:

Physically determined values of oxygen solubility in ml/l (from an atmosphere of 20.94% O_2 and 100% relative humidity).

t/°C	T[a]/K	Salinity/(‰)	O_2/(ml/l)
5.90	279.05	0.000	8.71
5.90	279.05	32.995	7.03
13.60	286.75	0.000	7.27
13.70	286.85	31.981	5.96
20.00	293.15	36.725	5.11
20.15	293.30	0.000	6.33
25.72	298.87	0.000	5.71
24.65	297.80	34.261	4.77
28.31	301.46	0.000	5.42

[a] Calculated by compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Saturation of samples with oxygen was carried out by stirring at such a rate that a vortex of ~ 3 cm in length was formed. The ratio of the volume of seawater (measured by weight) gives the solubility.

SOURCE AND PURITY OF MATERIALS:

(1) > 99.9% purity.

ESTIMATED ERROR:

$\delta T/K = \pm 0.02$
δS ‰ $= \pm 0.02$
$\delta O_2 = \pm 0.01$ ml/l

REFERENCES:

1. Murray, C. N.; Riley, J. P.; Wilson, T. R. S. *Deep-Sea Research*, 1969, *16*, 297.
2. Murray, C. N.; Riley, J. P. *Deep-Sea Research*, 1969, *16*, 311.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Oxygen; O_2; [7782-44-7] (2) Seawater	Murray, C. N.; Riley, J. P. *Deep-sea Research*, 1969, *16*, 311-20.
VARIABLES: T/K = 274-308 Salinity	PREPARED BY: Chen-Tung A. Chen.

EXPERIMENTAL VALUES:

Chemically determined values of oxygen solubility in ml/l. (from an atmosphere of 20.94% O_2 and 100% relative humidity).

t/°C (T^a/K)	Salinity/ (‰)	O_2/ (ml/l)	t/°C (T^a/K)	Salinity/ (‰)	O_2/ (ml/l)
	0.000	10.021		0.000	7.031
	5.962	9.622		10.090	6.618
0.74	11.418	9.241	15.12	15.084	6.395
(273.89)	19.999	8.743	(288.27)	20.774	6.172
	36.103	7.834		29.102	5.863
	0.000	9.713		0.000	6.360
	7.520	9.249		10.090	5.971
1.80	14.480	8.791	20.00	15.446	4.788
(274.95)	24.459	8.232	(293.15)	28.781	5.362
	29.148	8.022		39.020	5.045
	0.000	8.910		0.000	5.794
	11.577	8.281		8.712	5.464
4.90	17.508	7.959	24.95	12.646	5.348
(278.05)	25.870	7.571	(298.10)	22.169	5.098
	36.989	7.022		33.894	4.765
	0.000	8.382		0.000	5.312
	9.680	7.891		8.682	5.064
7.45	17.663	7.470	29.80	16.690	4.831
(280.60)	25.243	7.140	(302.95)	25.435	4.611
	31.513	6.836		33.626	4.400
	37.882	6.561		39.120	4.254

continued on following page

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Air saturated sample was introduced at the top of a helix (diameter 7 cm; length 360 cm.) at a rate of ≃ 4 ml/min to ensure that the sample was saturated, but not super-saturated. Thiosulfate was used to titrate the solution after the reagents ($MnCl_2 \cdot 4H_2O$, NaI, NaOH, H_2SO_4) had been added. The end point was determined photometrically with an EEL Quantitrator fitted with an Ilford 608 filter. Starch was used as the end point indicator. Used a modified Winkler method. See references.

SOURCE AND PURITY OF MATERIALS:

(1) From air.

ESTIMATED ERROR:

$\delta T/K = \pm 0.02$
$\delta S‰ = \pm 0.02‰$
$\delta O_2/(ml/l) = \pm 0.01$

REFERENCES:

1. Murry, C. N.; Riley, J. P.; Wilson, T. R. S. *Deep-Sea Research*, 1968, *15*, 237.
2. Murry, C. N.; Riley, J. P. *Deep-Sea Research* 1969, *16*, 311.

COMPONENTS:

(1) Oxygen; O_2; [7782-44-7]

(2) Seawater

EVALUATOR: ORIGINAL MEASUREMENTS

Murray, C. N.; Riley, J. P.

Deep-Sea Research, 1969, *16*, 311-20.

EXPERIMENTAL VALUES:

t/°C (T^a/K)	Salinity/ (‰)	O_2 (ml/l)
	0.000	7.887
	10.566	7.364
9.95	17.508	7.045
(283.10)	23.355	6.775
	31.935	6.445
	40.201	6.110

continued

t/°C (T^a/K)	Salinity (‰)	O_2/ (ml/l)
	0.000	4.862
	8.569	4.641
34.80	14.019	4.528
(307.95)	23.651	4.293
	34.205	4.067

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Oxygen; O_2; [7782-44-7] (2) Artificial Seawater	Kinsman, D.J.J.; Boardman, M.; Borcsik, M. *Symp. Salt. 4th*, 1973 (pub. 1973), *1*, 325-7.
VARIABLES: T/K = 293-323 Chlorinity	PREPARED BY: Chen-Tung A. Chen

EXPERIMENTAL VALUES:

t/°C	T^a/K	Cl/‰	$O_2{}^b$ (mg/kg water)	t/°C	T^a/K	Cl/‰	$O_2{}^b$ (mg/kg water)
22.5	295.7	18.57	7.15	23.0	296.2	122.51	2.63
23.0	296.2	18.59	7.28	22.5	295.7	122.53	2.60
23.75	296.9	18.76	6.91	23.75	296.9	123.6	2.63
22.0	295.2	18.81	6.83	21.0	294.2	128.19	2.40
21.0	294.2	20.45	7.01	22.0	295.2	128.84	2.48
22.0	295.2	20.60	7.12				
23.0	296.2	37.88	6.06				
22.5	295.7	38.16	5.78				
22.0	295.2	38.31	5.67				
23.75	296.9	38.54	5.69				
21.0	294.2	41.24	5.71				
22.0	295.2	41.54	5.85				
23.0	296.2	59.60	4.69				
22.5	295.7	60.14	4.65				
22.0	295.2	60.27	4.57				
23.75	296.9	61.23	4.57				
21.0	294.2	64.35	4.48				
22.0	295.2	64.63	4.56				
23.0	296.2	98.31	3.36				
22.0	295.2	98.48	3.60				
22.5	295.7	98.53	3.33				
23.75	296.9	99.04	3.31				
21.0	294.2	104.60	3.10				
22.0	295.2	105.54	3.17				
22.0	295.2	121.69	2.58				

continued on following page

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
Standard Winkler Method.	Oxygen: air Marine brines: unspecified
	ESTIMATED ERROR: δT = 2°C δO_2 < 4%
	REFERENCES: 1. Kinsman, D. J. *Private communication*, 1981.

COMPONENTS:

(1) Oxygen; O_2; [7782-44-7]

(2) Artificial Seawater

EVALUATOR:

Kinsman, D.J.J.; Boardman, M.; Borcsik, M.

Symp. Salt. 4th, 1973 (pub. 1973), *1*, 325-7.

CRITICAL EVALUATION: continued

Cl/‰	O_2[b] (mg/kg water)	Cl/‰	O_2[b] (mg/kg water)
	t/°C = 50 (323K)		
18.20	5.03	96.08	2.63
18.90	4.94	97.04	2.61
20.25	4.98	104.14	2.55
20.74	4.90	104.80	2.55
24.29	4.78	111.47	2.48
25.80	4.73	118.34	2.34
27.85	4.63	119.96	2.27
38.43	4.22	121.45	2.08
39.67	4.20	127.85	2.14
41.14	4.18	128.67	2.09
41.21	4.196	137.13	1.88
51.85	3.80	140.79	1.89
54.89	3.73	144.35	1.79
58.52	3.59		
63.65	3.40		
64.45	3.32		
74.78	3.43		
65.69	3.35		
81.51	2.99		
84.13	2.88		
90.23	2.85		

[a] Calculated by compiler.

[b] The oxygen partial pressure was 0.2 atm.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Oxygen; O_2; [7782-44-7]	Taylor, C. D.
(2) Seawater	*Undersea Biomed. Res.* 1979, *6*, 147-54.
VARIABLES:	**PREPARED BY:**
T/K = 293 P/MPa (Hydrostatic) = 1-61	Chen-Tung A. Chen, R. Battino

EXPERIMENTAL VALUES:

Oxygen Partial Pressure/atm	Hydrostatic Pressure/atm	O_2/ (μmole/liter)
0.036 (3.6 kPa)[b]	80 (8.1 MPa)[c]	40
0.036 (3.6 kPa)	160 (16.2 MPa)	60
0.036 (3.6 kPa)	580 (58.8 MPa)	180
0.065 (6.6 kPa)	200 (20.3 MPa)	170
0.065 (6.6 kPa)	400 (40.5 MPa)	260
0.065 (6.6 kPa)	600 (60.8 MPa)	420
0.094 (9.5 kPa)	200 (20.3 MPa)	220
0.094 (9.5 kPa)	400 (40.5 MPa)	380
0.094 (9.5 kPa)	570 (57.8 MPa)	580
0.12 (12 kPa)	200 (20.3 MPa)	250
0.12 (12 kPa)	440 (44.6 MPa)	560
0.12 (12 kPa)	600 (60.8 MPa)	740
0.15 (15 kPa)	100 (10.1 MPa)	180
0.15 (15 kPa)	200 (20.3 MPa)	320
0.15 (15 kPa)	300 (30.4 MPa)	460

[a] Oxygen solubility values at 20 °C (293K) estimated from Figure 3 given in the paper. Data were presented as average of duplicate analyses.

[b] Calculated in kPa by compiler.

[c] Calculated in MPa by compiler.

continued on following page

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Air-equilibrated artificial seawater was contained in a polycarbonate vessel housed in a stainless steel pressure cylinder. Oxygen-helium mixture was used in flushing gas and the partial pressure of it was monitored by a membrane-covered oxygen polarographic electrode. Flushing was continued until the partial O_2 pressure remained constant for at least 5 minutes, then the aqueous and gaseous phases were allowed to equilibrate with stirring at 20 °C for at least two hours prior to analysis by the Winkler method using undecompressed subsamples. Details also given in reference 1.

SOURCE AND PURITY OF MATERIALS:

(1) Union Carbide, 99.5% purity

(2) Artificial seawater: 4% Seven Seas Marine Mix; 0.1% Tris-base; 0.05% ammonium sulfate; pH 7.2-7.4.

ESTIMATED ERROR:

δO_2 < 12% , author's estimate

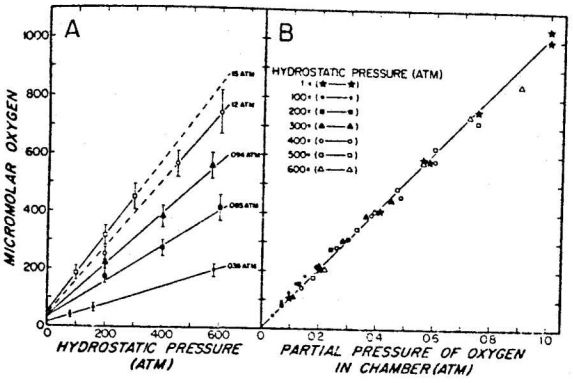
REFERENCES:

1. Taylor, C.D. *Appl. Environ. Microbiol.* 1979, 37, 42-9.

COMPONENTS:	EVALUATOR:
(1) Oxygen; O_2; [7782-44-7]	Taylor, C. D.
(2) Seawater	*Undersea Biomed. Res.* 1979, 6, 147-54.

CRITICAL EVALUATION:

continued



Data presented only in graphical form. Solubilities determined at 20°C (293K). The solubility is given in micromoles of oxygen per liter of seawater. In A the oxygen partial pressure is given for each line. The error bars are estimated from duplicate analyses. The starred date points in B were obtained from separate experiments conducted in bottles. Oxygen partial pressures were determined using a membrane-covered oxygen polarographic electrode.