<u>Table 1:</u> Initial Concentrations for three scenarios under polluted continental (urban), unpolluted continental (remote) and marine conditions (gas phase species in [ppb], aqueous phase species in [M])

	urban		remote		marine	
gas phase species						
NO_2	4.5	a	1.5	a	0.4	k
HNO_3	1	b	0.3	b	0.15	g
CH_4	1700	a	1700	a	1700	a
H_2O_2	1	d	0.001	a	0.001	a
H_2	2000	a	2000	a	2000	a
CO	200	a	150	a	140	a
O_3	90	a	60	a	40	a
HCl	6	a	0.7	b	0.5	g
NH_3	25	a	1.5	b	0.05	g
CO_2	$5 \cdot 10^5$	a	$3.3 \cdot 10^5$	b	$3.3 \cdot 10^5$	b
SO_2	10	h	1	h	0.1	h
HCHO	0.1	a	0.1	a	0.01	a
C_2H_6	2	a	1.5	a	1	a
HC3: Alkanes with OH rate constant between $2.7 \cdot 10^{-13}$ and $3.4 \cdot 10^{-12}$ cm^3 s^{-1} (298 K, 1 atm)	2	a	1	a	1	a
HC5: Alkanes with OH rate constant between $3.4 \cdot 10^{-12}$ and $6.8 \cdot 10^{-12}$ cm^3 s^{-1} (298 K, 1 atm)	1	a	0.5	a	0	a
HC8: Alkanes with OH rate constant greater than $6.8 \cdot 10^{-12}$ cm^3 s^{-1} (298 K, 1 atm)	0.1	a	0	a	0	a
C_2H_4	1	a	0.5	a	0.1	a
OLT: Terminal alkenes	0.1	a	0.1	a	0.1	a
Isoprene	0.1	a	0.1	a	0.1	a
TOL: Toluene and less reactive aromatics	0.1	a	0.01	a	0	a
CSL: Cresol and other OH-substituted aromatics	0.001	a	0.001	a	0	a
XYL: Xylene and more reactive aromatics	0.1	a	0.01	a	0	a
ALD: Acetaldehyde and higher aldehydes	0.1	a	0.1	a	0.01	a
Ketones	0.1	a	0.1	a	0.01	a
Glyoxal	0.1	a	0.1	a	0.01	a
Methylglyoxal	0.1	a	0.1	a	0.01	a
PAN	0.01	a	0.01	a	0.01	a
CH_3OOH	0.01	a	0.01	a	0.01	a
OP2: Higher organic peroxides	0.01	a	0.01	a	0.01	a
$CH_3C(O)OOH$	0.001	a	0.001	a	0.001	a
CH_3OH	5	a	2	f	0.8	g
EtOH	1	c	0.24	f	$2.4 \cdot 10^{-3}$	h

aqueous phase species

$O_{2(aq)}$	$3 \cdot 10^{-4}$	b	$3 \cdot 10^{-4}$	b	$3 \cdot 10^{-4}$	b
OH^-	$3.16 \cdot 10^{-10}$	b	$3.16 \cdot 10^{-10}$	b	$1.6 \cdot 10^{-9}$	b
pH	4.5	b	4.5	b	5.2	i
Cl^-	$1 \cdot 10^{-4}$	h	$1 \cdot 10^{-4}$	h	$5.6 \cdot 10^{-4}$	j
Br^-	$3 \cdot 10^{-6}$	h	$3 \cdot 10^{-7}$	h	$1.8 \cdot 10^{-6}$	j
Fe^{3+}	$5 \cdot 10^{-6}$	d	$5 \cdot 10^{-7}$	d	$5 \cdot 10^{-8}$	d
Mn^{3+}	$2.5 \cdot 10^{-7}$	d	$2.5 \cdot 10^{-8}$	d	$1 \cdot 10^{-9}$	d
Cu^+	$2.5 \cdot 10^{-7}$	d	$2.5 \cdot 10^{-8}$	d	$1 \cdot 10^{-9}$	d
HSO_4^-	$3 \cdot 10^{-7}$		$3 \cdot 10^{-7}$		$3 \cdot 10^{-8}$	
SO_4^{2-}	$5.97 \cdot 10^{-5}$	e	$5.97 \cdot 10^{-5}$	e	$5.97 \cdot 10^{-6}$	i

Constant concentrations

during the simulation time [ppb] or [M]:

$H_2O_{(g)}$	$2 \cdot 10^7$	$3 \cdot 10^7$	$3 \cdot 10^7$
$O_{2(g)}$	$2 \cdot 10^8$	$2 \cdot 10^8$	$2 \cdot 10^8$
$N_{2(g)}$	$7.8 \cdot 10^8$	$7.8 \cdot 10^8$	$7.8 \cdot 10^8$
$H_2O_{(aq)}$	55.5	55.5	55.5

[a] Zimmermann and Poppe, 1996; [b] Graedel and Weschler, 1981; [c] Saxena and Hildemann, 1996; [d] Matthijsen and Builtjes, 1995; [e] Weschler et al., 1986; [f] Leibrock and Slemr, 1996; [g] Jacob, 1986; [h] estimated ; [i] Chameides, 1984; [j] Herrmann *et al*., 1996; k Rohrer and Brüning, 1992

<u>Table 2:</u> Uptake Parameters

Table 2a: Henry's law constants

Reaction No.	Species	$K_{H\ 298}$, M atm^{-1}	ΔH_{298}, kJ mol^{-1}	References
H1	CO_2	$3.11 \cdot 10^{-2}$	-20.14	Chameides, 1984
H2	HCl	1.10	-16.8	Marsh and McElroy, 1985
H3	NH_3	60.7	-32.6	Clegg and Brimblecombe, 1990
H4	O_3	$1.14 \cdot 10^{-2}$	-19.1	Kosak-Channing and Helz, 1983
H5	HO_2	$9 \cdot 10^{3}$		Weinstein-Lloyd and Schwartz, 1991
H6	OH	25	-43.9	Kläning et al., 1985 National Bureau of Standards, 1971
H7	H_2O_2	$1.02 \cdot 10^{5}$	-52.7	Lind and Kok, 1994
H8	HNO_3	$2.1 \cdot 10^{5}$	-72.3	Lelieveld and Crutzen, 1991
H9	NO_3	0.6		Rudich *et al.*, 1996
H10	N_2O_5	1.4		[i]
H11	NO_2	$1.2 \cdot 10^{-2}$	-10.5	Schwartz and White, 1982
H12	HNO_2	49	-40.6	Park and Lee, 1988
H13	HO_2NO_2	$1 \cdot 10^{5}$ [d]		$K_{H13} = K_{H7}$
H14	SO_2	1.24	-27	Beilke and Gravenhorst, 1978
H15	HCHO[a]	$3.0 \cdot 10^{3}$	-60	Betterton and Hoffmann, 1988a
H16	CH_3OOH	6	-44.2	Lind and Kok, 1994
H17	$CH_3C(O)OOH$	$6.69 \cdot 10^{2}$	-49.0	Lind and Kok, 1994
H18	CH_3OH	$2.2 \cdot 10^{2}$	-44.8	Betterton, 1992
H19	C_2H_5OH	$1.9 \cdot 10^{2}$	-52.3	Betterton, 1992
H20	CH_3CHO[b]	11.4	-52	Betterton and Hoffmann, 1988a
H21	HCOOH	$5.53 \cdot 10^{3}$	-46.8	Khan and Brimblecombe, 1992
H22	CH_3COOH	$5.50 \cdot 10^{3}$	-49.0	Khan and Brimblecombe, 1992
H23	CH_3O_2	6	-46.9	Jacob, 1986
H24	ETHP[c]	6[d]	-46.9[d]	$K_{H24} = K_{H23}$
H25	Cl_2	$9.15 \cdot 10^{-2}$	20.7	Wilhelm *et al.*, 1977
H26	Br_2	0.758	31.6	Loomis, 1928
H27	H_2SO_4	$2.1 \cdot 10^{5}$		$K_{H27} = K_{H8}$
H28	CH_4	$1.46 \cdot 10^{-3}$		Mackay and Shan, 1981
H29	C_2H_6	$1.95 \cdot 10^{-3}$		Mackay and Shan, 1981
H30	C_2H_4	$4.55 \cdot 10^{-3}$		Mackay and Shan, 1981
H31	PAN[e]	5		Holdren et al., 1984
H32	OP2[f]	837		O'Sullivan et al., 1996
H33	OL2P[g]	6		$K_{H33} = K_{H23}$
H34	ACO_3[h]	669		$K_{H34} = K_{H17}$

[a] Equilibrium HCHO (g) ↔ $CH_2(OH)_2$ (aq).; [b] Equilibrium CH_3CHO (g) ↔ $CH_3CH(OH)_2$ (aq).; [c] Peroxy radical with 2 carbon atoms.; [d] Estimated value.; [e] Peroxy acetyl nitrate [f] C_2 - hydroperoxides; [g] Peroxy radicals of C_2H_4; [h] Acetyl peroxy radical; [i] estimated $K_{H(N2O5)} = K_{H(N2O4)}$ (Schwartz and White, 1983)

<u>Table 2b:</u> Mass accommodation coefficients and Gas Phase Diffusion Coefficients

Reaction No.	Species	α	References	D_g $[10^5\ m^2\ s^{-1}]$	References
H1	CO_2	$2 \cdot 10^{-4}$	estimated	1.55	McElroy, 1997
H2	HCl	0.064	Davidovits *et al.*, 1995	1.89	Marsh and McElroy, 1985
H3	NH_3	0.04	Bongartz, 1995	2.3	Ponche, 1993
H4	O_3	0.05	Mirabel, 1996	1.48	Schwartz, 1986
H5	HO_2	0.01	Hanson, 1992	1.04	Hanson, 1992
H6	OH	0.05	estimated	1.53	Hanson, 1992
H7	H_2O_2	0.11	Davidovits *et al.*, 1995	1.46	McElroy, 1997
H8	HNO_3	0.054	Davidovits *et al.*, 1995	1.32	Kirchner, 1990
H9	NO_3	$4 \cdot 10^{-3}$	Kirchner, 1990 Rudich, 1996	1.00	Thomas, 1998
H10	N_2O_5	$3.7 \cdot 10^{-3}$	George, 1986	1.10	Kirchner, 1990
H11	NO_2	$1.5 \cdot 10^{-3}$	estimated	1.92	Ponche, 1993
H12	HNO_2	0.5	Bongartz, 1995	1.30	Kirchner, 1990
H13	HO_2NO_2	0.1	Jacob, 1986	1.30	Schweitzer, 1998
H14	SO_2	$3.5 \cdot 10^{-2}$	Tang and Lee, 1987 Gardner, 1987	1.28	McElroy, 1997
H15	HCHO[a]	0.02	estimated	1.64	Fuller, 1986 a)
H16	CH_3OOH	$3.8 \cdot 10^{-3}$	Davidovits *et al.*, 1995	1.31	Fuller, 1986 a)
H17	$CH_3C(O)OOH$	0.019	$\alpha_{17} = \alpha_{31}$	1.02	Fuller, 1986 a)
H18	CH_3OH	$1.5 \cdot 10^{-2}$	Davidovits *et al.*, 1995	1.16	Schwartz, 1986
H19	C_2H_5OH	$8.2 \cdot 10^{-3}$	Davidovits *et al.*, 1995	0.95	Schwartz, 1986
H20	CH_3CHO[b]	0.03	estimated	1.22	Fuller, 1986 a)
H21	HCOOH	0.012	Davidovits *et al.*, 1995	1.53	Schwartz, 1986
H22	CH_3COOH	0.019	Davidovits *et al.*, 1995	1.24	Schwartz, 1986
H23	CH_3O_2	$3.8 \cdot 10^{-3}$	$\alpha_{23} = \alpha_{16}$	1.35	Fuller, 1986 a)
H24	ETHP[c]	$8.2 \cdot 10^{-3}$	estimated	1.08	Fuller, 1986 a)
H25	Cl_2	0.03	estimated	1.28	Schwartz, 1986
H26	Br_2	0.03	estimated	1.00	Schwartz, 1986
H27	H_2SO_4	0.07	Davidovits *et al.*, 1995	1.30	Schwartz, 1986
H28	CH_4	$5 \cdot 10^{-5}$	estimated	1.41	Fuller, 1986 a)
H29	C_2H_6	$1 \cdot 10^{-4}$	estimated	0.95	Fuller, 1986 a)
H30	C_2H_4	$1 \cdot 10^{-4}$	estimated	1.01	Fuller, 1986 a)
H31	PAN[e]	0.019	$\alpha_{31} = \alpha_{22}$	0.63	Fuller, 1986 a)
H32	OP2[f]	0.01	estimated	0.76	Fuller, 1986 a)
H33	OL2P[g]	$8.2 \cdot 10^{-3}$	$\alpha_{33} = \alpha_{24}$	0.82	Fuller, 1986 a)
H34	ACO_3[h]	0.019	$\alpha_{34} = \alpha_{22}$	1.0	Fuller, 1986 a)

a) These values are calculated after the method by Fuller,1986

Table 3: **HO_x- and Transition metal ion (TMI)-Chemistry**

Reaction No.	Reaction	k_{298}, $M^{-n}\ s^{-1}$	E_a / R, K	Reference
R1	$H_2O_2 + Fe^{3+} \rightarrow HO_2 + H^+ + Fe^{2+}$	$2{\cdot}10^{-3}$		Walling and Goosen, 1973
R2	$H_2O_2 + [Fe(OH)]^{2+} \rightarrow HO_2 + H_2O + Fe^{2+}$	$2{\cdot}10^{-3}$		$k_2 = k_1$
R3	$H_2O_2 + [Fe(OH)_2]^+ \rightarrow HO_2 + OH^- + Fe^{2+} + H_2O$	$2{\cdot}10^{-3}$		$k_3 = k_1$
R4	$H_2O_2 + Fe^{2+} \rightarrow OH + OH^- + Fe^{3+}$	76		Walling, 1975
R5	$H_2O_2 + Mn^{3+} \rightarrow HO_2 + H^+ + Mn^{2+}$	$7.3 \cdot 10^4$		Davies *et al.*, 1968
R6	$H_2O_2 + Cu^+ \rightarrow OH + OH^- + Cu^{2+}$	$7.0 \cdot 10^3$		Berdnikov, 1973
R7	$O_2^- + Fe^{3+} \rightarrow O_2 + Fe^{2+}$	$1.5 \cdot 10^8$		Rush and Bielski, 1985
R8	$HO_2 + [Fe(OH)]^{2+} \rightarrow Fe^{2+} + O_2 + H_2O$	$1.3 \cdot 10^5$		Ziajka *et al.*, 1994
R9	$O_2^- + [Fe(OH)]^{2+} \rightarrow O_2 + Fe^{2+} + OH^-$	$1.5 \cdot 10^8$		Rush and Bielski, 1985
R10	$O_2^- + [Fe(OH)_2]^+ \rightarrow O_2 + Fe^{2+} + 2\ OH^-$	$1.5 \cdot 10^8$		Rush and Bielski, 1985
R11	$O_2^- + Fe^{2+}$ $(+ 2\ H^+)$ $\rightarrow H_2O_2 + Fe^{3+}$	$1.0 \cdot 10^7$		Rush and Bielski, 1985
R12	$HO_2 + Fe^{2+}$ $(+ H^+)$ $\rightarrow H_2O_2 + Fe^{3+}$	$1.2 \cdot 10^6$	5050	Jayson *et al.*, 1973b
R13	$OH + Fe^{2+} \rightarrow [Fe(OH)]^{2+}$	$4.3 \cdot 10^8$	1100	Christensen and Sehested, 1981
R14	$O_2^- + Mn^{2+}$ $(+ H^+)$ $\rightarrow H_2O_2 + Mn^{3+}$	$1.1 \cdot 10^8$		Pick-Kaplan and Rabani, 1976
R15	$HO_2 + Mn^{2+}$ $(+ H^+)$ $\rightarrow H_2O_2 + Mn^{3+}$	$2 \cdot 10^5$		Graedel *et al.*, 1986
R16	$OH + Mn^{2+} \rightarrow OH^- + Mn^{3+}$	$2.6 \cdot 10^7$		Baral *et al.*, 1986
R17	$O_2^- + Cu^+$ $(+ 2\ H^+)$ $\rightarrow H_2O_2 + Cu^{2+}$	$9.4 \cdot 10^9$		von Piechowski *et al.*, 1993
R18	$HO_2 + Cu^+$ $(+ H^+)$ $\rightarrow H_2O_2 + Cu^{2+}$	$2.2 \cdot 10^9$		Kozlov and Berdnikov, 1973
R19	$OH + Cu^+ \rightarrow OH^- + Cu^{2+}$	$3 \cdot 10^9$		Goldstein *et al.*, 1992
R20	$HO_2 + Cu^{2+} \rightarrow O_2 + Cu^+ + H^+$	$1.2 \cdot 10^9$		Cabelli *et al.*, 1987
R21	$O_2^- + Cu^{2+} \rightarrow O_2 + Cu^+$	$1.1 \cdot 10^{10}$		Cabelli *et al.*, 1987
R22	$Fe^{3+} + Cu^+ \rightarrow Fe^{2+} + Cu^{2+}$	$3 \cdot 10^7$		Sedlak and Hoigné, 1993
R23	$[Fe(OH)]^{2+} + Cu^+ \rightarrow Fe^{2+} + Cu^{2+} + OH^-$	$3 \cdot 10^7$		Sedlak and Hoigné, 1993
R24	$[Fe(OH)_2]^+ + Cu^+ \rightarrow Fe^{2+} + Cu^{2+} + 2\ OH^-$	$3 \cdot 10^7$		Sedlak and Hoigné, 1993
R25	$Fe^{2+} + Mn^{3+} \rightarrow Fe^{3+} + Mn^{2+}$	$1.5 \cdot 10^4$		Diebler and Sutin, 1964
R26	$O_3 + O_2^-$ $(+ H^+)$ $\rightarrow 2\ O_2 + OH$	$1.5 \cdot 10^9$		Sehested *et al.*, 1983

R27	$HO_2 + HO_2 \rightarrow O_2 + H_2O_2$	$8.3 \cdot 10^5$	2720	Bielski *et al.*, 1985
R28	$HO_2 + O_2^- (+ H^+) \rightarrow H_2O_2 + O_2$	$9.7 \cdot 10^7$	1060	Bielski *et al.*, 1985
R29	$HO_2 + OH \rightarrow H_2O + O_2$	$1.0 \cdot 10^{10}$		Elliot and Buxton, 1992
R30	$O_2^- + OH \rightarrow OH^- + O_2$	$1.1 \cdot 10^{10}$	2120	Christensen *et al.*, 1989
R31	$H_2O_2 + OH \rightarrow HO_2 + H_2O$	$3.0 \cdot 10^7$	1680	Christensen *et al.*, 1982
R32	$MHP + OH \rightarrow CH_3O_2 + H_2O$	$3.0 \cdot 10^{7}$ [b]	1680 [b]	$k_{R32} = k_{R31}$
R33	$HSO_3^- + OH \rightarrow H_2O + SO_3^-$	$2.7 \cdot 10^9$		Buxton *et al.*, 1996a
R34	$SO_3^{2-} + OH \rightarrow OH^- + SO_3^-$	$4.6 \cdot 10^9$		Buxton *et al.*, 1996a

Table 4: Nitrogen-Chemistry

Reaction No.	Reaction	k_{298}, $M^{-n}\ s^{-1}$	E_a / R, K	Reference
R35	$N_2O_5 + H_2O \rightarrow 2\ H^+ + 2\ NO_3^-$	$5 \cdot 10^9$		estimated
R36	$NO_3 + OH^- \rightarrow NO_3^- + OH$	$9.4 \cdot 10^7$	2700	Exner *et al.*, 1992
R37	$NO_3 + Fe^{2+} \rightarrow NO_3^- + Fe^{3+}$	$8 \cdot 10^6$		Pikaev *et al.*, 1974
R38	$NO_3 + Mn^{2+} \rightarrow NO_3^- + Mn^{3+}$	$1.1 \cdot 10^6$		Neta and Huie, 1986
R39	$NO_3 + H_2O_2 \rightarrow NO_3^- + H^+ + HO_2$	$4.9 \cdot 10^6$	2000	Herrmann *et al.*, 1994
R40	$NO_3 + MHP \rightarrow NO_3^- + H^+ + CH_3O_2$	$4.9 \cdot 10^{6\ b}$	$2000^{\ b}$	$k_{R40} = k_{R39}$
R41	$NO_3 + HO_2 \rightarrow NO_3^- + H^+ + O_2$	$3.0 \cdot 10^9$		Sehested *et al.*, 1994
R42	$NO_3 + O_2^- \rightarrow NO_3^- + O_2$	$3 \cdot 10^{9\ b}$		$k_{R42} = k_{R41}$
R43	$NO_3 + HSO_3^- \rightarrow NO_3^- + H^+ + SO_3^-$	$1.3 \cdot 10^9$	2000	Exner *et al.*, 1992
R44	$NO_3 + SO_3^{2-} \rightarrow NO_3^- + SO_3^-$	$3.0 \cdot 10^8$		Exner *et al.*, 1992
R45	$NO_3 + HSO_4^- \rightarrow NO_3^- + H^+ + SO_4^-$	$2.6 \cdot 10^5$		Raabe, 1996
R46	$NO_3 + SO_4^{2-} \rightarrow NO_3^- + SO_4^-$	$5.6 \cdot 10^3$		Logager *et al.*, 1993
R47	$NO_2 + OH \rightarrow NO_3^- + H^+$	$1.2 \cdot 10^{10}$		Wagner *et al.*, 1980
R48	$NO_2 + O_2^- \rightarrow NO_2^- + O_2$	$1 \cdot 10^8$		Warneck and Wurzinger, 1988
R49	$NO_2 + NO_2 (+ H_2O) \rightarrow HNO_2 + NO_3^- + H^+$	$8.4 \cdot 10^7$	-2900	Park and Lee, 1988
R50	$O_2NO_2^- \rightarrow NO_2^- + O_2$	$4.5 \cdot 10^{-2}$		Lammel *et al.*, 1990
R51	$NO_2^- + OH \rightarrow NO_2 + OH^-$	$1.1 \cdot 10^{10}$		Barker *et al.*, 1970
R52	$NO_2^- + SO_4^- \rightarrow SO_4^{2-} + NO_2$	$7.2 \cdot 10^8$		Reese, 1997
R53	$NO_2^- + NO_3 \rightarrow NO_3^- + NO_2$	$1.4 \cdot 10^9$	0	Herrmann and Zellner, 1998
R54	$NO_2^- + Cl_2^- \rightarrow 2\ Cl^- + NO_2$	$6 \cdot 10^7$		Jacobi, 1996
R55	$NO_2^- + Br_2^- \rightarrow 2\ Br^- + NO_2$	$1.2 \cdot 10^7$	1720	Shoute *et al.*, 1991
R56	$NO_2^- + CO_3^- \rightarrow CO_3^{2-} + NO_2$	$6.6 \cdot 10^5$	850	Huie *et al.*, 1991a
R57	$NO_2^- + O_3 \rightarrow NO_3^- + O_2$	$5 \cdot 10^5$	7000	Damschen and Martin, 1983
R58	$HNO_2 + OH \rightarrow NO_2 + H_2O$	$1 \cdot 10^9$		Rettich, 1978
R59	$HNO_4 + HSO_3^- \rightarrow HSO_4^- + NO_3$	$3.5 \cdot 10^5$		Amels *et al.*, 1996

Table 5: Sulfur-Chemistry

Reaction No.	Reaction	k_{298}, $M^{-n}\ s^{-1}$	E_a / R, K	Reference
R60	$HMS^- + OH\ (+ O_2 + H_2O) \rightarrow H_2O + HO_2 + HCOOH + HSO_3^-$	$3 \cdot 10^8$		Buxton, 1994
R61	$HMS^- + SO_4^- \rightarrow SO_4^{2-} + H^+ + HCHO + SO_3^-$	$2.8 \cdot 10^6$		Buxton, 1994
R62	$HMS^- + NO_3 \rightarrow NO_3^- + H^+ + HCHO + SO_3^-$	$4.2 \cdot 10^6$		Herrmann and Zellner, 1998
R63	$HMS^- + Cl_2^- \rightarrow 2\ Cl^- + H^+ + HCHO + SO_3^-$	$5.0 \cdot 10^5$		Jacobi, 1996
R64	$HMS^- + Br_2^- \rightarrow 2\ Br^- + H^+ + HCHO + SO_3^-$	$5 \cdot 10^4$		estimated
R65	$HSO_3^- + H_2O_2 + H^+ \rightarrow SO_4^{2-} + H_2O + 2\ H^+$	$6.9 \cdot 10^7$	4000	Lind *et al.*, 1987
R66	$HSO_3^- + CH_3OOH + H^+ \rightarrow SO_4^{2-} + 2\ H^+ + CH_3OH$	$1.8 \cdot 10^7$	3800	Lind *et al.*, 1987
R67	$HSO_3^- + CH_3C(O)OOH + H^+ \rightarrow SO_4^{2-} + 2\ H^+ + P$	$4.8 \cdot 10^7$	3990	Lind *et al.*, 1987
R68	$SO_2 + O_3\ (+H_2O) \rightarrow HSO_4^- + O_2 + H^+$	$2.4 \cdot 10^4$		Hoffmann, 1986
R69	$HSO_3^- + O_3 \rightarrow HSO_4^- + O_2$	$3.7 \cdot 10^5$	5530	Hoffmann, 1986
R70	$SO_3^{2-} + O_3 \rightarrow SO_4^{2-} + O_2$	$1.5 \cdot 10^9$	5280	Hoffmann, 1986
R71	$[Fe(OH)]^{2+} + HSO_3^- \rightarrow Fe^{2+} + SO_3^- + H_2O$	39		Ziajka *et al.*, 1994
R72	$Fe^{2+} + SO_5^-\ (+H_2O) \rightarrow [Fe(OH)]^{2+} + HSO_5^-$	$4.3 \cdot 10^7$		Herrmann *et al.*, 1996
R73	$Fe^{2+} + HSO_5^- \rightarrow [Fe(OH)]^{2+} + SO_4^-$	$3 \cdot 10^4$		Ziajka *et al.*, 1994
R74	$Mn^{2+} + SO_5^-\ (+H_2O) \rightarrow Mn^{3+} + HSO_5^- + OH^-$	$4.6 \cdot 10^6$		Herrmann *et al.*, 1996
R75	$Fe^{2+} + SO_4^-\ (+H_2O) \rightarrow [Fe(OH)]^{2+} + SO_4^{2-} + H^+$	$3.5 \cdot 10^7$		Ziajka *et al.*, 1994
R76	$Fe^{2+} + S_2O_8^{2-}\ (+H_2O) \rightarrow [Fe(OH)]^{2+} + SO_4^{2-} + SO_4^- + H^+$	17		Buxton *et al.*, 1997
R77	$SO_5^- + SO_5^- \rightarrow S_2O_8^{2-} + O_2$	$1.8 \cdot 10^8$	2600	Herrmann *et al.*, 1995
R78	$SO_5^- + SO_5^- \rightarrow 2\ SO_4^- + O_2$	$7.2 \cdot 10^6$	2600	Herrmann *et al.*, 1995
R79	$SO_5^- + HO_2 \rightarrow HSO_5^- + O_2$	$1.7 \cdot 10^9$		Buxton *et al.*, 1996b
R80	$SO_5^- + O_2^-\ (+H_2O) \rightarrow HSO_5^- + OH^- + O_2$	$1.7 \cdot 10^{9\ b}$		$k_{R80} = k_{R79}$
R81	$SO_3^- + O_2 \rightarrow SO_5^-$	$2.5 \cdot 10^9$		Buxton *et al.*, 1996a
R82	$SO_5^- + HSO_3^- \rightarrow HSO_5^- + SO_3^-$	$8.6 \cdot 10^3$		Buxton *et al.*, 1996a
R83	$SO_5^- + HSO_3^- \rightarrow SO_4^{2-} + SO_4^- + H^+$	$3.6 \cdot 10^2$		Buxton *et al.*, 1996a
R84	$SO_5^- + SO_3^{2-}\ (+H^+) \rightarrow HSO_5^- + SO_3^-$	$2.13 \cdot 10^5$		Buxton *et al.*, 1996a
R85	$SO_5^- + SO_3^{2-} \rightarrow SO_4^- + SO_4^{2-}$	$5.5 \cdot 10^5$		Buxton *et al.*, 1996a
R86	$OH + HSO_4^- \rightarrow H_2O + SO_4^-$	$3.5 \cdot 10^5$		Tang *et al.*, 1988

R87	$SO_4^- + SO_4^- \rightarrow S_2O_8^{2-}$	$1.6 \cdot 10^8$		Herrmann *et al.*, 1995a
R88	$SO_4^- + HSO_3^- \rightarrow SO_4^{2-} + SO_3^- + H^+$	$3.2 \cdot 10^8$		Reese, 1997
R89	$SO_4^- + SO_3^{2-} \rightarrow SO_4^{2-} + SO_3^-$	$3.2 \cdot 10^8$	1200	Reese, 1997
R90	$SO_4^- + Fe^{2+} \rightarrow [Fe(SO_4)]^+$	$3 \cdot 10^8$		McElroy and Waygood, 1990
R91	$SO_4^- + Mn^{2+} \rightarrow SO_4^{2-} + Mn^{3+}$	$2 \cdot 10^7$		Neta and Huie, 1986
R92	$SO_4^- + Cu^+ \rightarrow SO_4^{2-} + Cu^{2+}$	$3 \cdot 10^{8\,b}$		$k_{R92} = k_{R90}$
R93	$SO_4^- + H_2O_2 \rightarrow SO_4^{2-} + H^+ + HO_2$	$2.8 \cdot 10^7$		Reese, 1997
R94	$SO_4^- + MHP \rightarrow SO_4^{2-} + H^+ + CH_3O_2$	$2.8 \cdot 10^{7\,b}$		$k_{R94} = k_{R93}$
R95	$SO_4^- + HO_2 \rightarrow SO_4^{2-} + H^+ + O_2$	$3.5 \cdot 10^9$		Jiang *et al.*, 1992
R96	$SO_4^- + O_2^- \rightarrow SO_4^{2-} + O_2$	$3.5 \cdot 10^{9\,b}$		$k_{R96} = k_{R95}$
R97	$SO_4^- + NO_3^- \rightarrow SO_4^{2-} + NO_3$	$5.0 \cdot 10^4$		Exner *et al.*, 1992
R98	$SO_4^- + OH^- \rightarrow SO_4^{2-} + OH$	$1.4 \cdot 10^7$		Herrmann *et al.*, 1995
R99	$SO_4^- + H_2O \rightarrow SO_4^{2-} + H^+ + OH$	11	1110	Herrmann *et al.*, 1995
R100	$HSO_5^- + HSO_3^- + H^+ \rightarrow 2\ SO_4^{2-} + 3\ H^+$	$7.14 \cdot 10^6$		Betterton and Hoffmann, 1988b
R101	$HSO_5^- + SO_3^{2-} + H^+ \rightarrow 2\ SO_4^{2-} + 2\ H^+$	$7.14 \cdot 10^6$		Betterton and Hoffmann, 1988b
R102	$HSO_5^- + OH \rightarrow SO_5^- + H_2O$	$1.7 \cdot 10^7$		Maruthamuthu and Neta, 1977

Table 6: Organic Chemistry

Reaction No.	Reaction	k_{298}, $M^{-n}\ s^{-1}$	E_a / R, K	Reference
R103	$CH_3OH + OH (+ O_2) \rightarrow H_2O + HO_2 + HCHO$	$1.0 \cdot 10^9$	580	Elliot and McCracken, 1989
R104	$CH_3OH + SO_4^- (+ O_2) \rightarrow SO_4^{2-} + H^+ + HO_2 + HCHO$	$9.0 \cdot 10^6$	2190	Clifton and Huie, 1989
R105	$CH_3OH + NO_3 (+ O_2) \rightarrow NO_3^- + H^+ + HO_2 + HCHO$	$5.4 \cdot 10^5$	4300	Herrmann and Zellner, 1998
R106	$CH_3OH + Cl_2^- (+ O_2) \rightarrow 2\ Cl^- + H^+ + HO_2 + HCHO$	1000	5500	Zellner *et al.*, 1996
R107	$CH_3OH + Br_2^- (+ O_2) \rightarrow 2\ Br^- + H^+ + HO_2 + HCHO$	$5.4 \cdot 10^5$		Wicktor, 1997
R108	$CH_3OH + CO_3^- (+ O_2) \rightarrow CO_3^{2-} + H^+ + HO_2 + HCHO$	$2.6 \cdot 10^3$		Zellner *et al.*, 1996
R109	$ETOH + OH (+ O_2) \rightarrow H_2O + HO_2 + CH_3CHO$	$1.9 \cdot 10^9$		Buxton *et al.*, 1988a
R110	$ETOH + SO_4^- (+ O_2) \rightarrow SO_4^{2-} + H^+ + HO_2 + CH_3CHO$	$4.1 \cdot 10^7$	1760	Clifton and Huie, 1989
R111	$ETOH + NO_3 (+ O_2) \rightarrow NO_3^- + H^+ + HO_2 + CH_3CHO$	$2.2 \cdot 10^6$	3300	Herrmann and Zellner, 1998
R112	$ETOH + Cl_2^- (+ O_2) \rightarrow 2\ Cl^- + H^+ + HO_2 + CH_3CHO$	$1.2 \cdot 10^5$		Zellner *et al.*, 1996
R113	$ETOH + Br_2^- (+ O_2) \rightarrow 2\ Br^- + H^+ + HO_2 + CH_3CHO$	$3.8 \cdot 10^3$		Reese *et al.*, 1999
R114	$ETOH + CO_3^- (+ O_2) \rightarrow CO_3^{2-} + H^+ + HO_2 + CH_3CHO$	$1.5 \cdot 10^4$		Khuz'min, 1972
R115	$CH_2(OH)_2 + OH (+ O_2) \rightarrow H_2O + HO_2 + HCOOH$	$1.0 \cdot 10^9$	1020	Hart *et al.*, 1964; Chin and Wine, 1994
R116	$CH_2(OH)_2 + SO_4^- (+ O_2) \rightarrow SO_4^{2-} + H^+ + HO_2 + HCOOH$	$1.4 \cdot 10^7$	1300	Buxton *et al.*, 1990
R117	$CH_2(OH)_2 + NO_3 (+ O_2) \rightarrow NO_3^- + H^+ + HO_2 + HCOOH$	$1.0 \cdot 10^6$	4500	Exner *et al.*, 1993
R118	$CH_2(OH)_2 + Cl_2^- (+ O_2) \rightarrow 2\ Cl^- + H^+ + HO_2 + HCOOH$	$3.1 \cdot 10^4$	4400	Zellner *et al.*, 1996
R119	$CH_2(OH)_2 + Br_2^- (+ O_2) \rightarrow 2\ Br^- + H^+ + HO_2 + HCOOH$	$3 \cdot 10^3$ [b]		estimated
R120	$CH_2(OH)_2 + CO_3^- (+ O_2) \rightarrow CO_3^{2-} + H^+ + HO_2 + HCOOH$	$1.3 \cdot 10^4$		Zellner *et al.*, 1996
R121	$CH_3CH(OH)_2 + OH (+ O_2) \rightarrow H_2O + HO_2 + HAc$	$1.2 \cdot 10^9$		Schuchmann and von Sonntag, 1988
R122	$CH_3CHO + OH (+ O_2 + H_2O) \rightarrow H_2O + HO_2 + HAc$	$3.6 \cdot 10^9$		Schuchmann and von Sonntag, 1988
R123	$CH_3CH(OH)_2 + SO_4^- (+ O_2) \rightarrow SO_4^{2-} + H^+ + HO_2 + HAc$	$2 \cdot 10^7$ [b]		estimated
R124	$CH_3CH(OH)_2 + NO_3 (+ O_2) \rightarrow NO_3^- + H^+ + HO_2 + HAc$	$1.9 \cdot 10^6$		Zellner *et al.*, 1996
R125	$CH_3CH(OH)_2 + Cl_2^- (+ O_2) \rightarrow 2\ Cl^- + H^+ + HO_2 + HAc$	$4 \cdot 10^4$		Jacobi, 1996
R126	$CH_3CH(OH)_2 + Br_2^- (+ O_2) \rightarrow 2\ Br^- + H^+ + HO_2 + HAc$	$4 \cdot 10^4$		estimated
R127	$CH_3CH(OH)_2 + CO_3^- (+ O_2) \rightarrow CO_3^{2-} + H^+ + HO_2 + HAc$	$1 \cdot 10^4$		estimated
R128	$HCOOH + OH (+ O_2) \rightarrow H_2O + HO_2 + CO_2$	$1.3 \cdot 10^8$	1000	Buxton *et al.*, 1988a; Chin and Wine, 1994
R129	$HCOO^- + OH (+ O_2) \rightarrow OH^- + HO_2 + CO_2$	$4 \cdot 10^9$	1000	Buxton *et al.*, 1988a;

				Elliot and Simsons, 1984
R130	$HCOOH + SO_4^- \ (+ O_2) \rightarrow SO_4^{2-} + H^+ + HO_2 + CO_2$	$2.5 \cdot 10^6$		Reese, 1997
R131	$HCOO^- + SO_4^- \ (+ O_2) \rightarrow SO_4^{2-} + HO_2 + CO_2$	$2.1 \cdot 10^7$		Reese, 1997
R132	$HCOOH + NO_3 \ (+ O_2) \rightarrow NO_3^- + H^+ + HO_2 + CO_2$	$3.8 \cdot 10^5$	3400	Exner *et al.*, 1994
R133	$HCOO^- + NO_3 \ (+ O_2) \rightarrow NO_3^- + HO_2 + CO_2$	$5.1 \cdot 10^7$	2200	Exner *et al.*, 1994
R134	$HCOOH + Cl_2^- \ (+ O_2) \rightarrow 2\ Cl^- + H^+ + HO_2 + CO_2$	5500	4500	Jacobi *et al.*, 1999
R135	$HCOO^- + Cl_2^- \ (+ O_2) \rightarrow 2\ Cl^- + HO_2 + CO_2$	$1.3 \cdot 10^6$		Jacobi *et al.*, 1996
R136	$HCOOH + Br_2^- \ (+ O_2) \rightarrow 2\ Br^- + H^+ + HO_2 + CO_2$	$4 \cdot 10^3$		Reese *et al.*, 1999
R137	$HCOO^- + Br_2^- \ (+ O_2) \rightarrow 2\ Br^- + HO_2 + CO_2$	$4.9 \cdot 10^3$		Jacobi, 1996
R138	$HCOO^- + CO_3^- \ (+ O_2) \rightarrow CO_3^{2-} + HO_2 + CO_2$	$1.4 \cdot 10^5$	3300	Zellner *et al.*, 1996
R139	$HAc + OH \ (+ O_2) \rightarrow H_2O + ACO_3 + CO_2$	$1.5 \cdot 10^7$	1330	Thomas, 1965; Chin and Wine, 1994
R140	$Ac^- + OH \ (+ O_2) \rightarrow OH^- + ACO_3 + CO_2$	$1.0 \cdot 10^9$	1800	Fisher and Hamill, 1973; Chin and Wine, 1994
R141	$HAc + SO_4^- \ (+ O_2) \rightarrow SO_4^{2-} + H^+ + ACO_3 + CO_2$	$2.0 \cdot 10^5$		Reese, 1997
R142	$Ac^- + SO_4^- \ (+ O_2) \rightarrow SO_4^{2-} + CH_3O_2 + CO_2$	$2.8 \cdot 10^7$	1210	Reese, 1997; Huie and Clifton, 1990
R143	$HAc + NO_3 \ (+ O_2) \rightarrow NO_3^- + H^+ + ACO_3 + CO_2$	$1.4 \cdot 10^4$	3800	Exner *et al.*, 1994
R144	$Ac^- + NO_3 \ (+ O_2) \rightarrow NO_3^- + CH_3O_2 + CO_2$	$2.9 \cdot 10^6$	3800	Exner *et al.*, 1994
R145	$HAc + Cl_2^- \ (+ O_2) \rightarrow 2\ Cl^- + H^+ + ACO_3 + CO_2$	1950	4800	Jacobi *et al.*, 1998
R146	$Ac^- + Cl_2^- (+ O_2) \rightarrow 2\ Cl^- + CH_3O_2 + CO_2$	$2.6 \cdot 10^5$	4800	Jacobi *et al.*, 1996
R147	$HAc + Br_2^- \ (+ O_2) \rightarrow 2\ Br^- + H^+ + ACO_3 + CO_2$	10		Reese *et al.*, 1999
R148	$Ac^- + Br_2^- \ (+ O_2) \rightarrow 2\ Br^- + CH_3O_2 + CO_2$	100		Jacobi, 1996
R149	$Ac^- + CO_3^- \ (+ O_2) \rightarrow CO_3^{2-} + CH_3O_2 + CO_2$	580		Zellner *et al.*, 1996
R150	$CH_3O_2 + CH_3O_2 \rightarrow CH_3OH + HCHO + O_2$	$1.7 \cdot 10^8$	2200	Herrmann *et al.*, 1999b)
R151	$CH_3O_2 + HSO_3^- \rightarrow MHP + SO_3^-$	$5 \cdot 10^5$		Herrmann *et al.*, 1999b)
R152	$ETHP + ETHP \rightarrow Prod.$	$1.5 \cdot 10^{8\ c}$	-1500	Herrmann *et al.*, 1999b)

<u>Table 7:</u> Chlorine chemistry

Reaction No.	Reaction	k_{298}, $M^{-n}\ s^{-1}$	E_a / R, K	Reference
R153	$SO_4^- + Cl^- \rightarrow SO_4^{2-} + Cl$	$3.3 \cdot 10^8$	0	Huie and Clifton, 1990; Herrmann *et al.*, 1997
R154	$NO_3 + Cl^- \rightarrow NO_3^- + Cl$	$1.0 \cdot 10^7$	4300	Exner *et al.*, 1992
R155	$Cl_2^- + Cl_2^- \rightarrow Cl_2 + 2\ Cl^-$	$8.7 \cdot 10^8$		Zellner *et al.*, 1996
R156	$Cl_2^- + Fe^{2+} \rightarrow 2\ Cl^- + Fe^{3+}$	$1.0 \cdot 10^7$	3030	Thornton and Laurence, 1973
R157	$Cl_2^- + Mn^{2+} \rightarrow 2\ Cl^- + Mn^{3+}$	$8.5 \cdot 10^6$	4090	Laurence and Thornton, 1973
R158	$Cl_2^- + Cu^+ \rightarrow 2\ Cl^- + Cu^{2+}$	$1 \cdot 10^7$		$k_{R158} = k_{R156}$
R159	$Cl_2^- + H_2O_2 \rightarrow 2\ Cl^- + H^+ + HO_2$	$7.0 \cdot 10^5$	3340	Elliot, 1989
R160	$Cl_2^- + MHP \rightarrow 2\ Cl^- + H^+ + CH_3O_2$	$7.0 \cdot 10^5$	3340	$k_{R160} = k_{R159}$
R161	$Cl_2^- + OH^- \rightarrow 2\ Cl^- + OH$	$4.0 \cdot 10^6$		Jacobi, 1996
R162	$Cl_2^- + HO_2 \rightarrow 2\ Cl^- + H^+ + O_2$	$1.3 \cdot 10^{10}$		Jacobi, 1996
R163	$Cl_2^- + O_2^- \rightarrow 2\ Cl^- + O_2$	$6 \cdot 10^9$		Jacobi, 1996
R164	$Cl_2^- + HSO_3^- \rightarrow 2\ Cl^- + H^+ + SO_3^-$	$1.7 \cdot 10^8$	400	Jacobi *et al.*, 1996
R165	$Cl_2^- + SO_3^{2-} \rightarrow 2\ Cl^- + SO_3^-$	$6.2 \cdot 10^7$		Jacobi *et al.*, 1996
R166	$Cl_2 + H_2O \rightarrow H^+ + Cl^- + HOCl$	0.401	7900	Wang and Margerum, 1994

<u>Table 8:</u> Bromine chemistry

Reaction No.	Reaction	k_{298}, $M^{-n}\ s^{-1}$	E_a / R, K	Reference
R167	$SO_4^- + Br^- \rightarrow SO_4^{2-} + Br$	$2.1 \cdot 10^9$		Herrmann *et al.*, 1997
R168	$NO_3 + Br^- \rightarrow NO_3^- + Br$	$3.8 \cdot 10^9$		Zellner *et al.*, 1996
R169	$Br_2^- + Br_2^- \rightarrow Br_2 + 2\ Br^-$	$1.7 \cdot 10^9$		Reese, 1998
R170	$Br_2^- + Fe^{2+} \rightarrow 2\ Br^- + Fe^{3+}$	$3.6 \cdot 10^6$	3330	Thornton and Laurence, 1973
R171	$Br_2^- + Mn^{2+} \rightarrow 2\ Br^- + Mn^{3+}$	$6.3 \cdot 10^6$	4330	Laurence and Thornton, 1973
R172	$Br_2^- + Cu^+ \rightarrow 2\ Br^- + Cu^{2+}$	$3.6 \cdot 10^6$		$k_{R172} = k_{R170}$
R173	$Br_2^- + H_2O_2 \rightarrow 2\ Br^- + H^+ + HO_2$	$1.0 \cdot 10^5$		Reese, 1997
R174	$Br_2^- + MHP \rightarrow 2\ Br^- + H^+ + CH_3O_2$	$1.0 \cdot 10^5$		$k_{R174} = k_{R172}$
R175	$Br_2^- + OH^- \rightarrow 2\ Br^- + OH$	$1.1 \cdot 10^4$		Jacobi, 1996
R176	$Br_2^- + HO_2 \rightarrow 2\ Br^- + H^+ + O_2$	$6.5 \cdot 10^9$		Rafi and Sutton, 1965
R177	$Br_2^- + O_2^- \rightarrow 2\ Br^- + O_2$	$1.7 \cdot 10^8$		Wagner and Strehlow, 1987
R178	$Br_2^- + HSO_3^- \rightarrow 2\ Br^- + H^+ + SO_3^-$	$5.0 \cdot 10^7$	780	Shoute *et al.*, 1991
R179	$Br_2^- + SO_3^{2-} \rightarrow 2\ Br^- + SO_3^-$	$3.3 \cdot 10^7$	650	Shoute *et al.*, 1991
R180	$Br_2 + H_2O \rightarrow Br^- + H^+ + HOBr$	1.7	7500	Beckwith *et al.*, 1996

<u>Table 9:</u> Carbonate chemistry

Reaction No.	Reaction[a]	k_{298}, $M^{-n}\ s^{-1}$	E_a / R, K	Reference
R181	$HCO_3^- + OH \rightarrow H_2O + CO_3^-$	$1.7 \cdot 10^7$	1900	Exner, 1990
R182	$CO_3^{2-} + OH \rightarrow OH^- + CO_3^-$	$3.9 \cdot 10^8$	2840	Buxton *et al.*, 1988a,b
R183	$CO_3^{2-} + SO_4^- \rightarrow SO_4^{2-} + CO_3^-$	$4.1 \cdot 10^7$		estimated
R184	$HCO_3^- + SO_4^- \rightarrow SO_4^{2-} + CO_3^- + H^+$	$2.8 \cdot 10^6$	2090	Huie and Clifton, 1990
R185	$CO_3^{2-} + NO_3 \rightarrow NO_3^- + CO_3^-$	$4.1 \cdot 10^7$		estimated
R186	$CO_3^{2-} + Cl_2^- \rightarrow 2\ Cl^- + CO_3^-$	$2.7 \cdot 10^6$		estimated
R187	$CO_3^{2-} + Br_2^- \rightarrow 2\ Br^- + CO_3^-$	$1.1 \cdot 10^5$		Huie *et al.*, 1991b
R188	$CO_3^- + CO_3^-\ (+O_2) \rightarrow 2\ O_2^- + 2\ CO_2$	$2.2 \cdot 10^6$		Huie and Clifton, 1990
R189	$CO_3^- + Fe^{2+} \rightarrow CO_3^{2-} + Fe^{3+}$	$2 \cdot 10^7$		estimated
R190	$CO_3^- + Mn^{2+} \rightarrow CO_3^{2-} + Mn^{3+}$	$1.5 \cdot 10^7$		Cope *et al.*, 1978
R191	$CO_3^- + Cu^+ \rightarrow CO_3^{2-} + Cu^{2+}$	$2 \cdot 10^7$		estimated
R192	$CO_3^- + H_2O_2 \rightarrow HCO_3^- + HO_2$	$4.3 \cdot 10^5$		Draganic *et al.*, 1991
R193	$CO_3^- + MHP \rightarrow HCO_3^- + CH_3O_2$	$4.3 \cdot 10^5$		$k_{R193} = k_{R192}$
R194	$CO_3^- + HO_2 \rightarrow HCO_3^- + O_2$	$6.5 \cdot 10^8$		$k_{R194} = k_{R195}$
R195	$CO_3^- + O_2^- \rightarrow CO_3^{2-} + O_2$	$6.5 \cdot 10^8$		Eriksen *et al.*, 1985
R196	$CO_3^- + HSO_3^- \rightarrow HCO_3^- + SO_3^-$	$1 \cdot 10^7$		estimated
R197	$CO_3^- + SO_3^{2-} \rightarrow CO_3^{2-} + SO_3^-$	$5.0 \cdot 10^6$	470	Huie *et al.*, 1991a

<u>Table 10:</u> CAPRAM: Aqueous phase equilibria

No.	Reaction	K M^z	k(forward) $M^{-n}\ s^{-1}$	E_a / R, K		k(back) $M^{-n}\ s^{-1}$	E_a / R, K	
E1	$H_2O \rightleftharpoons H^+ + OH^-$	$1.8 \cdot 10^{-14}$	$2.34 \cdot 10^{-5}$	6800	a	$1.3 \cdot 10^{11}$		c
E2	$CO_2 + H_2O \rightleftharpoons H_2CO_3$	$7.7 \cdot 10^{-7}$	$4.3 \cdot 10^{-2}$	9250	b	$5.6 \cdot 10^{4}$	8500	x
E3	$H_2CO_3 \rightleftharpoons H^+ + HCO_3^-$	$2 \cdot 10^{-4}$	$1 \cdot 10^{7}$		c	$5 \cdot 10^{10}$		c
E4	$HCO_3^- \rightleftharpoons H^+ + CO_3^{2-}$	$4.69 \cdot 10^{-11}$	2.35	1820	a	$5 \cdot 10^{10}$		c
E5	$HCl \rightleftharpoons H^+ + Cl^-$	$1.72 \cdot 10^{6}$	$8.6 \cdot 10^{16}$	-6890	d	$5 \cdot 10^{10}$		c
E6	$NH_3 + H_2O \rightleftharpoons NH_4^+ + OH^-$	$1.77 \cdot 10^{-5}$	$6.02 \cdot 10^{5}$	560	a	$3.4 \cdot 10^{10}$		c
E7	$HO_2 \rightleftharpoons H^+ + O_2^-$	$1.6 \cdot 10^{-5}$	$8.0 \cdot 10^{5}$	0	e, f	$5 \cdot 10^{10}$	0	y
E8	$HNO_3 \rightleftharpoons H^+ + NO_3^-$	22	$1.1 \cdot 10^{12}$	-1800	g, h	$5 \cdot 10^{10}$		c
E9	$HNO_2 \rightleftharpoons H^+ + NO_2^-$	$5.3 \cdot 10^{-4}$	$2.65 \cdot 10^{7}$	1760	i	$5 \cdot 10^{10}$		c
E10	$HO_2NO_2 \rightleftharpoons H^+ + O_2NO_2^-$	$1 \cdot 10^{-5}$	$5 \cdot 10^{5}$		j	$5 \cdot 10^{10}$		y
E11	$NO_2 + HO_2 \rightleftharpoons HO_2NO_2$	$2.2 \cdot 10^{9}$	$1.0 \cdot 10^{7}$		k	$4.6 \cdot 10^{-3}$		k
E12	$SO_2 + H_2O \rightleftharpoons HSO_3^- + H^+$	$3.13 \cdot 10^{-4}$	$6.27 \cdot 10^{4}$	-1940	l	$2.0 \cdot 10^{8}$		c
E13	$HSO_3^- \rightleftharpoons SO_3^{2-} + H^+$	$6.22 \cdot 10^{-8}$	3110	-1960	l	$5 \cdot 10^{10}$		c
E14	$HSO_4^- \rightleftharpoons SO_4^{2-} + H^+$	$1.02 \cdot 10^{-2}$	$1.02 \cdot 10^{9}$	-2700	g	$1 \cdot 10^{11}$		c
E15	$HCOOH \rightleftharpoons HCOO^- + H^+$	$1.77 \cdot 10^{-4}$	$8.85 \cdot 10^{6}$	-12	a	$5 \cdot 10^{10}$		c
E16	$HAc \rightleftharpoons Ac^- + H^+$	$1.75 \cdot 10^{-5}$	$8.75 \cdot 10^{5}$	-46	a	$5 \cdot 10^{10}$		c
E17	$Fe^{3+} + H_2O \rightleftharpoons [Fe(OH)]^{2+} + H^+$	$1.1 \cdot 10^{-4}$	$4.7 \cdot 10^{4}$		m	$4.3 \cdot 10^{8}$		m
E18	$[Fe(OH)]^{2+} + H_2O \rightleftharpoons [Fe(OH)_2]^+ + H^+$	$1.4 \cdot 10^{-7}$	$1.1 \cdot 10^{3}$		n	$8.0 \cdot 10^{9}$		n
E19	$Fe^{3+} + SO_4^{2-} \rightleftharpoons [Fe(SO_4)]^+$	$1.8 \cdot 10^{-2}$	$3.2 \cdot 10^{3}$		m	$1.8 \cdot 10^{5}$		m
E20	$HCHO + H_2O \rightleftharpoons CH_2(OH)_2$	36	0.18	-4030	o	$5.1 \cdot 10^{-3}$		o
E21	$CH_3CHO + H_2O \rightleftharpoons CH_3CH(OH)_2$	$2.46 \cdot 10^{-2}$	$1.4 \cdot 10^{-4}$	-2500	p	$5.69 \cdot 10^{-3}$		p
E22	$CH_2(OH)_2 + HSO_3^- \rightleftharpoons HMS^- + H_2O$	$2 \cdot 10^{8}$	790	2990	q	$3.95 \cdot 10^{-6}$	2990	q
E23	$CH_2(OH)_2 + SO_3^{2-} \rightleftharpoons HMS^- + OH^-$	$3.6 \cdot 10^{6}$	$2.5 \cdot 10^{7}$	2450	r	$3.95 \cdot 10^{-6}$	5530	q
E24	$Cl + Cl^- \rightleftharpoons Cl_2^-$	$1.9 \cdot 10^{5}$	$2.7 \cdot 10^{10}$		r	$1.4 \cdot 10^{5}$		t
E25	$Br + Br^- \rightleftharpoons Br_2^-$	$6 \cdot 10^{5}$	$1.2 \cdot 10^{10}$		s	$1.9 \cdot 10^{4}$		s

E26	$Cl^- + OH \rightleftharpoons ClOH^-$	0.7	$4.3 \cdot 10^{9}$	t	$6.1 \cdot 10^{9}$	t
E27	$ClOH^- + H^+ \rightleftharpoons Cl + H_2O$	$1.6 \cdot 10^{7}$	$2.1 \cdot 10^{10}$	t	$1.3 \cdot 10^{3}$	t
E28	$ClOH^- + Cl^- \rightleftharpoons Cl_2^- + OH^-$	$2.2 \cdot 10^{-4}$	$1.0 \cdot 10^{4}$	u	$4.5 \cdot 10^{7}$	u
E29	$Br^- + OH \rightleftharpoons BrOH^-$	333	$1.1 \cdot 10^{10}$	v	$3.3 \cdot 10^{7}$	v
E30	$BrOH^- + H^+ \rightleftharpoons Br + H_2O$	$1.8 \cdot 10^{12}$	$4.4 \cdot 10^{10}$	w	$2.45 \cdot 10^{-2}$	w
E31	$BrOH^- + Br^- \rightleftharpoons Br_2^- + OH^-$	70	$1.9 \cdot 10^{8}$	w	$2.7 \cdot 10^{6}$	w

[a] Harned and Owen, 1958; [b] Welch *et al.*, 1969; [c] Graedel and Weschler, 1981; [d] Marsh and McElroy, 1985; [e] Bielski *et al.*, 1985; [f] Baxendale et al., 1971; [g] Redlich, 1946; [h] Redlich and Hood, 1957; [i] Park and Lee, 1988; [j] Lammel *et al.*, 1990; [k] Warneck and Wurzinger, 1988; [l] Beilke and Gravenhorst, 1978; [m] Brandt and van Eldik, 1995; [n] Hemmes *et al.*, 1971; [o] Bell and Evans, 1966; [p] Bell *et al.*, 1956; [q] Olson and Hoffmann, 1989; [r] Jacobi *et al.*, 1997; [s] Merényi and Lind, 1994; [t] Jayson *et al.*, 1973; [u] Grigor'ev et al., 1987; [v] Klaning and Wolff, 1985; [w] Fornier de Violet, 1981; [x] Sirs, 1958; [y] estimated ;

Table 11: **Photolysis Rates (Aqueous Phase), geographical latitude of 51° N.**

Reaction No.	Reaction	J [s^{-1}]	Range of Quantum Yield Φ	References
P1	$H_2O_2 + h\nu \rightarrow 2\ OH$	$7.19 \cdot 10^{-6}$	0.98 ± 0.03^a	Zellner et al., 1990
			0.96 ± 0.03^b	Zellner et al., 1990
P2	$[Fe(OH)]^{2+} + h\nu \rightarrow Fe^{2+} + OH$	$4.51 \cdot 10^{-3}$	$0.312 \pm 0.03 \ldots 0.074 \pm 0.015^c$	Benkelberg and Warneck, 1995
P3	$[Fe(OH)_2]^+ + h\nu \rightarrow Fe^{2+} + OH + OH^-$	$5.77 \cdot 10^{-3}$	$0.255 \ldots 0.07^d$	Benkelberg et al., 1991
P4	$[Fe(SO_4)]^+ + h\nu \rightarrow Fe^{2+} + SO_4^-$	$6.43 \cdot 10^{-3}$	$(7.9 \pm 0.34 \ldots 1.56 \pm 0.02) \cdot 10^{-3\ c}$	Benkelberg and Warneck,1995
P5	$NO_2^- + h\nu\ (+H^+) \rightarrow NO + OH$	$2.57 \cdot 10^{-5}$	0.07 ± 0.01^a	Zellner et al., 1990
			0.046 ± 0.009^b	Zellner et al., 1990
P6	$NO_3^- + h\nu\ (+H^+) \rightarrow NO_2 + OH$	$4.28 \cdot 10^{-7}$	0.017 ± 0.003	Zellner et al., 1990

[a] λ = 308 nm, T = 298 K; [b] λ = 351 nm, T = 298 K; [c] λ = 280 ... 370 nm; [d] λ = 290...365 nm

References

Amels, P., Elias H., Götz, U., Steinges, U. and Wannowius, K. J., 1996, Kinetic investigation of the stability of peroxonitric acid and of its reaction with sulfur(IV) in aqueous solution. In: „Heterogeneous and Liquid Phase Processes“ (P. Warneck, ed.) Vol. 2 of Transport and Chemical Transformation of Pollutants in the Troposphere (P. Borrell, P. M. Borrell, T. Cvitas, K. Kelly and W. Seiler, Series Editors), Springer, Berlin, 77-88.

Baral, S., Lume-Pereira, C., Janata, E. and Henglein, A., 1986, Chemistry of colloidal manganese oxides. 3. Formation in the reaction of hydroxyl radicals with Mn^{2+} ions, *J.Phys.Chem.* **90**, 6025 - 6028.

Barker, G. C., Fowles, P., and Stringer, B., 1970, Pulse radiolytic induced transient electrical conductance in liquid solutions of NO_3^-, NO_2^- and $Fe(CN)_6^{3-}$, *Trans.Faraday Soc.* **66**, 1509 - 1519.

Barlow, S., Buxton, G. V., Murray, S. A., and Salmon, G. A., 1997, Oxidation of hydroxymethanesulfonate initiated by the hydroxyl radical, in P.M. Borrell, P. Borrell, T. Cvitaš, K. Kelly and W. Seiler (eds), *Proceedings of EUROTRAC Symposium ‘96: Transport and Transformation of Pollutants in the Troposphere Vol. 1*, 361 - 365, Computational Mechanics Publications, Southampton, UK.

Baxendale, J. H., Ward, M. D., and Wardman, P., 1971, Heats of Formation of HO_2 and OH in Aqueous Solution, *Trans.Faraday Soc.* **67**, 2532 - 2537.

Beckwith, R. C., Wang, T. X., and Margerum, D. W., 1996, Equilibrium and Kinetics of Bromine Hydrolysis, *Inorg.Chem.* **35**, 995 - 1000.

Beilke, S. and Gravenhorst, G., 1978, Heterogeneous SO_2-Oxidation in the Droplet Phase, *Atmos.Environm.* **12**, 231 -239.

Bell, R. P., 1966, The reversible Hydration of Carbonyl compounds, *Adv.Phys.Org.Chem.* **4**, 1-29.

Bell, R. P. and Evans, P. G., 1966, Kinetics of the dehydration of methylene glycol in aqueous solution, *Proc.R.Soc.London Ser.A* **291**, 297 - 323.

Bell, R. P., Rand, M. H., and Wynne-Jones, K. M. A., 1956, Kinetics of the hydration of acetaldehyde, *Trans.Faraday Soc.* **52**, 1093 - 1102.

Benkelberg, H.-J., Schäfer, A. and Warneck, P., 1991, *Air Pollution Research Report 33: Atmospheric Oxidation Processes*, ed. K.-H. Becker, CEC, Brussels, 130.

Benkelberg, H.-J. and Warneck, P. 1995, Photodecomposition of Iron(III) Hydroxo and Sulfato Complexes in Aqueous Solution: Wavelength Dependence of OH and SO_4^- Quantum Yields, *J. Phys. Chem*., **99**, 5214-5221.

Berdnikov, V. M., 1973, Catalytic Activity of the Hydrated Copper Ion in the Decomposition of Hydrogen Peroxide, *Russ.J.Phys.Chem.* **47**, 1060 - 1062.

Betterton, E. A., 1992, Henry’s law constants of soluble and moderately soluble organic gases: Effects on aqueous phase chemistry, in J.O. Nriagu (ed), *Gaseous Pollutants: Characterization and Cycling*, 1 - 50, Wiley, New York.

Betterton, E. A. and Hoffmann, M. R., 1988a, Henry’s Law Constants of Some Environmentally Important Aldehydes, *Environ.Sci.Technol.* **22**, 1415 - 1418.

Betterton, E. A. and Hoffmann, M. R., 1988b, Oxidation of Aqueous SO_2 by Peroxymonosulfate, *J.Phys.Chem.* **92**, 5962 - 5965.

Betterton, E.A., Erel, Y., and Hoffmann, M. R., 1988, Aldehyde-Bisulfite Adducts: Prediction of Some of Their Thermodynamic and Kinetic Properties, *Environ.Sci.Technol.* **22**, 92 - 99.

Bielski, B. H. J., Cabelli, D. E., Arudi, R. L., and Ross, A. B., 1985, Reactivity of HO_2/O_2^- radicals in aqueous solution, *J.Phys.Chem.Ref.Data* **14**, 1041 - 1100.

Bongartz, A., Schweighoefer, S., Roose, C. and Schurath, U., 1995, The Mass Accommodation Coefficient of Ammonia on Water, *J. Atm. Chem.* **20**, 35-58.

Bothe, E., Schuchmann, M. N., Schulte-Frohlinde, D. and von Sonntag, C., 1983, Hydroxyl radical-induced oxidation of ethanol in oxygenated aqueous solutions. A pulse radiolysis and product study, *Z. Naturforsch.* **38b**, 212 - 219.

Boyce, S. D. and Hoffmann, M. R., 1984, Kinetics and Mechanism of the Formation of Hydroxymethanesulfonic Acid at Low pH, *J. Phys. Chem.* **88**, 4740-4746

Brandt, C. and van Eldik, R., 1995, Transition Metal-Catalyzed Oxidation of Sulfur(IV)Oxides. Atmospheric Relevant Processes and Mechanisms, *Chem.Rev.* **95**, 119 - 190.

Buxton, G. V., 1994, Mechanisms for chemical reactions in cloud droplets, in P. M. Borrell, P. Borrell, T. Cvitaš and W. Seiler (eds), *Proceedings of EUROTRAC Symposium ‘94: Transport and Transformation of Pollutants in the Troposphere*, 978 - 983, SPB Academic Publishing, The Hague, NL.

Buxton, G. V., Greenstock, C. L., Helman, W. P. and Ross, A. B., 1988a, Critical Review of rate constants for reactions of hydrated electrons, hydrogen atoms and hydroxyl radicals, (OH, O_2^-) in aqueous solution, *J.Phys.Chem.Ref.Data* **17**, 513 - 886.

Buxton, G. V., Wood, N. D. and Dyster, S., 1988b, Ionisation constants of OH and HO_2 in aqueous solution up to 200°C. A pulse radiolytic study, *J.Chem.Soc.Faraday Trans.* **84**, 1113 - 1121.

Buxton, G. V., Salmon, G. A., and Wood, N. D., 1990, A pulse radiolysis study of the chemistry of oxysulfur radicals in aqueous solution, in: G. Restelli and G. Angeletti (eds), *Proceedings of the Fifth European Symposium: Physico-Chemical Behaviour of Atmospheric Pollutants*, 245 - 250, Kluwer, Dordrecht, NL.

Buxton, G. V., McGowan, S., Salmon, G. A., Williams, J. E. and Wood, N. D., 1996a, A study of the spectra and reactivity of oxysulphur-radical anions involved in the chain oxidation of S(IV): a pulse and gamma-radiolysis study, *Atmos.Environm.* **30**, 2483 - 2493.

Buxton, G. V., Malone, T. N., and Salmon, G. A., 1996b, Pulse Radiolyis Study of the reaction of SO_5^- with HO_2, *J.Chem.Soc.Faraday Trans.* **92**, 1287 - 1289.

Buxton, G. V., Malone, T. N., and Salmon, A., 1997, Reaction of SO_4^- with Fe^{2+}, Mn^{2+} and Cu^+ in aqueous solution, *J. Chem.Soc.Faraday Trans*. **93**(16), 2893-2897.

Cabelli, D. E., Bielski, B. H. J., and Holcman, J., 1987, Interaction between copper(II)-arginine complexes and HO_2/O_2^--radicals, a pulse radiolytic study, *J.Am.Chem.Soc.* **109**, 3665 - 3669.

Chameides, W. L., 1984, The Photochemistry of a Remote Marine Stratiform Cloud, *J.Geophys.Res.* **89**, 4739 - 4755.

Chawla, O. P. and Fessenden, R. W., 1975, Electron Spin Resonance and pulse radiolysis studies of some reactions of SO_4^-, *J.Phys.Chem.* **79**, 2693 - 2700.

Chin, M. and Wine, P. H., 1994, A temperature-dependent competitive kinetics study of the aqueous-phase reactions of OH radicals with formate, formic acid, acetate, acetic acid and hydrated formaldeheyde, in G. R. Helz, R. G. Zepp and D. G. Crosby (eds*), Aquatic and Surface Photochemistry*, 85 - 96, Lewis Publishers, Boca Raton.

Christensen, H. and Sehested, K., 1981, Pulse radiolysis at high temperatures and high pressures, *Radiat.Phys.Chem.* **18**, 723 - 231.

Christensen, H., Sehested, K. and Corfitzen, H., 1982, Reactions of Hydroxyl Radicals with Hydrogen Peroxide at Ambient and Elevated Temperatures, *J.Phys.Chem.* **86**, 1588 - 1590.

Christensen, H., Sehested, K. and Bjergbakke, E., 1989, Radiolysis of reactor water: Reaction of hydroxyl radicals with superoxide (O_2^-), *Water Chem.Nucl.React.Syst.* **5**, 141 - 144.

Clegg, S. L. and Brimblecombe, P., 1990, Solubility of Volatile Electrolytes in Multicomponent Solutions with Atmospheric Applications, *ACS Symposium Series* **416**, 58 - 73.

Clifton, C. L. and Huie, R. E., 1989, Rate constants for hydrogen abstraction reactions of the sulfate radical SO_4^-. Alcohols, *Int.J.Chem.Kinet.* **21**, 677 - 687.

Cope, V. W., Hoffman, M. Z., and Chen, S., 1978, Reactivity of the carbonate radical toward metal complexes in aqueous solution, *J.Phys.Chem.* **82**, 2665 - 2669.

Damschen, D. E. and Martin, L. R., 1983, Aqueous aerosol oxidation of nitrous acid by O_2, O_3 and H_2O_2, *Atmos.Environm.* **17**, 2005 - 2011.

Davidovits, M., Hu, J. H., Worsnop, D. R., Zahniser, M. S. and Kolb, C. E.,1995, Entry of Gas Molecules into Liquids, *Faraday Discuss*., **100**, 65-82.

Davies, G., Kirschenbaum, L. J. and Kustin, K., 1968, The Kinetics and Stoichometry of the Reaction between Manganese(III) and and Hydrogen Peroxide in Acid Perchlorate Solution, *Inorg.Chem.* **7**, 146 - 154.

Deister, U. and Warneck, P., 1990, Photooxidation of SO_3^{2-} in Aqueous Solution, *J.Phys.Chem.* **94**, 2191 - 2198.

Diebler, H. and Sutin, N., 1964, The Kinetics of Some Oxidation-Reduction Reactions Involving Manganese(III), *J.Phys.Chem.* **68**, 174 - 180.

Draganic, Z. D., Negron-Mendoza, A., Sehested, K., Vujosevic, S. I., Navarro-Gonzales, R., Albarran-Sanchez, M. G., and Draganic, I. G., 1991, Radiolysis of aqueous solution of ammonium bicarbonate over a large dose range, *Radiat.Phys.Chem.* **38**, 317 - 321.

Elliot, A. J., 1989, A Pulse Radiolysis Study of the Temperature Dependence of Reactions involving H, OH and e^-_{aq} in Aqueous Solution, *Radiat.Phys.Chem.* **34**, 753 - 758.

Elliot, A. J. and Buxton, G. V., 1992, Temperature dependence of the reactions OH + O_2^- and OH + HO_2 in water up to 200 °C, *J.Chem.Soc.Faraday Trans.* **88**, 2465 - 2470.

Elliot, A. J. and McCracken, D. R., 1989, Effect of temperature on O^- reactions and equilibria: A pulse radiolytic study, *Radiat.Phys.Chem.* **33**, 69 - 74.

Elliot, A.J. and Simsons, A. S., 1984, Rate Constants for Reactions of Hydroxyl Radicals as a function of temperature, *Radiat.Phys.Chem.* **24**, 229 - 231.

Eriksen, T. E., Lind, J. and Merenyi, G., 1985, On the Acid- Base Equilibrium of the Carbonate Radical, *Radiat.Phys.Chem.* **26**, 197 - 199.

Exner, M., 1990, Diploma Thesis, Bildung und Reaktionen von Radikalen und Radikalanionen in wäßriger Phase, Georg-August-University Göttingen.

Exner, M., 1992, Ph.D. Thesis, Laserspektrometrische Untersuchungen von Reaktionen des NO_3-Radikals in wäßriger Lösung, Georg-August-University Göttingen.

Exner, M., Herrmann, H., and Zellner, R., 1990, A laser photolysis study of reactions of the carbonate radical anion (CO_3^-) in aqueous solution, in K. H. Becker (ed), *Air Pollution Research Report 33: Atmospheric Oxidation Processes*, 134 - 138, Office for official Publications of the European Communities, Luxembourg.

Exner, M., Herrmann, H., and Zellner, R., 1992, Laser-based studies of reactions of the nitrate radical in aqueous solution, *Ber.Bunsenges.Phys.Chem.* **96**, 470 - 477.

Exner, M., Herrmann, H., Michel, J. W. and Zellner, R., 1993, Laser pulse initiated measurements of NO_3 reactions with S(IV) and organic compounds in aqueous solutions, in P. M. Borrell, P. Borrell, T. Cvitaš and W. Seiler (eds), *Proceedings of EUROTRAC Symposium '92: Photo-oxidants: Precursors and Products*, 615 - 618, SPB Academic Publishing, The Hague, NL.

Exner, M., Herrmann, H. and Zellner, R., 1994, Rate Constants for the Reactions of the NO_3 Radical with $HCOOH/HCOO^-$ and CH_3COOH/CH_3COO^- in Aqueous Solution Between 278 and 328 K, *J.Atmos.Chem.* **18**, 359 - 378.

Fisher, M. M. and Hamill, W. H., 1973, Electronic processes in pulse-irradiated aqueous and alcoholic systems, *J.Phys.Chem.* **77**, 171 - 177.

Fornier de Violet, Ph., 1981, Polyhalide anions as intermediates in chemistry, *Rev. Chem. Intermed*. **4**, 121-69.

Fuller, E. N., Diffusion Coefficients for Binary Gas Systems at Low Pressures: Empirical Correlations, in C. Reid et al (eds.) *Properties of Gases and Liquids*, 587, Mc Graw Hill, New York.

Gardner, 1987, Measurement of the Mass Accommodation Coefficient of SO_2(g) on Water Droplets*, J. Geophys. Res.* **92**, 887.

George, C., 1994, Study of the Uptake of N_2O_5 by Water and NaCl Solutions, *J. Phys. Chem.* **98**, 8780.

Gilbert, B. C., Larkin, J. P. and Norman, R. O. C., 1972, Electron Spin Resonance Studies, Part XXXIV. The Use of the *aci*-Anion from Nitromethane as a Spin Trap for Organic Radicals in Aqueous Solution, *J.Chem.Soc. Perkin Trans. II*, 1272 - 1279.

Goldstein, S., Czapski, G., Cohen, H. and Meyerstein, D., 1992, Deamination of β-alanine induced by hydroxyl radicals and monovalent copper ions. A pulse radiolytic study, *Inorg.Chim.Acta* **192**, 87 - 93.

Graedel, T. E. and Weschler, C. J., 1981, Chemistry Within Aqueous Atmospheric Aerosols and Raindrops, *Rev.Geophys.Space Phys.* **19**, 505 - 539.

Graedel, T. E., Mandich, M. L. and Weschler, C. J., 1986, Kinetic model Studies of Atmosheric Droplet Chemistry 2. Homogeneous Transition Metal Chemistry in Raindrops, *J.Geophys.Res.* **91**, 5205 - 5221.

Grigor'ev, A. E., Makarov, I. E. and Pikaev, A. K., 1987, *High Energy Chem..* **21**, 99.

Hanson, D., 1992, Measurement of OH and HO_2 Radical Uptake Coefficients on Water and Sulfuric Acid Surfaces, *J. Phys. Chem.* **96**, 4979.

Harned, H. S. and Owen, B. B., 1958, *The Physical Chemistry of Electrolytic Solutions*, 3. ed., Reinhold, New York.

Hart, E. J., Thomas, J. K. and Gordon, S., 1964, A review of the radiation chemistry of single-carbon compounds and some reactions of the hydrated electron in aqueous solution, *Radiat.Res.Suppl.* **4**, 74 - 88.

Hemmes, P., Rich, L. D., Cole, D. L. and Eyring, E. M., 1971, Kinetics of Hydrolysis of Ferric Ion in Dilute Aqueous Solution, *J.Phys.Chem.* **75**, 929 - 932.

Herrmann, H., Exner, M., and Zellner, R., 1994, Reactivity trends in reactions of the nitrate radical (NO_3) with inorganic and organic cloudwater constituents *Geochim. Cosmo-chim.Acta* **58**, 3239 - 3244.

Herrmann, H., Reese, A., and Zellner, R., 1995, Time-resolved UV/VIS Diode Array Absorption Spectroscopy of SO_x^- (x = 3, 4, 5) Radical Anions in Aqueous Solution, *J.Mol.Struct.* **348**, 183 - 186.

Herrmann, H., Jacobi, H.-W., Raabe, G., Reese, A. and Zellner, R., 1996, Laser-spectrocopic laboratory studies of atmospheric aqueous phase free radical chemistry, *Fresenius J.Anal.Chem.* **355**, 343 - 344.

Herrmann, H., Jacobi, H.-W., Reese, A. and Zellner, R., 1997, Laboratory studies of small radicals and radical anions of interest for tropospheric aqueous phase chemistry: The reactivity of SO_4^-, in P. M. Borrell, P. Borrell, T. Cvitaš, K. Kelly and W. Seiler (eds), *Proceedings of EUROTRAC Symposium '96: Transport and Transformation of Pollutants in the Troposphere Vol. 1*, 407 - 411, Computational Mechanics Publications, Southampton, UK.

Herrmann, H. and Zellner, R., 1998, Reactions of NO_3 Radicals in Aqueous Solution, in: N-Centered Radicals, Edited by Z. B. Alfassi, John Wiley and Sons Ltd.

Herrmann, H., Ervens, B., Nowacki, P., Wolke, R. and Zellner, R., 1999a, A Chemical Aqueous Phase Radical Mechanism for Tropospheric Chemistry, *Chemosphere*, **Vol. 38**, No. 6, 1223-1232.

Herrmann, H., Reese, A., Ervens, B., Wicktor, F. and Zellner, R., 1999b, Laboratory and Modelling Studies of Tropospheric Multiphase Conversions Involving some C1 and C2 Peroxyl Radicals, *Phys. Chem. Earth*, **Vol. 24**, No 3, 287-290.

Hoffmann, M. R., 1986, On the Kinetics and Mechanism of Oxidation of Aquated Sulfur Dioxide by Ozone, *Atmos.Environm.* **20**, 1145 - 1154.

Hoigné, J., Bader, H., Haag, W. R. and Staehelin, J., 1985, Rate Constants of Reactions of Ozone with Organic and Inorganic Compounds in Water- III Inorganic Compounds and Radicals, *Water Res.* **19**, 993 - 1004.

Holdren, G. R., 1984, Peroxyacetyl Nitrate Solubility and Decomposition Rate in Acidic Water, *Atmos. Environm.* **18**, 1171.

Huie, R. E. and Clifton, C. L., 1990, Temperature Dependence of the Rate Constants for Reactions of the Sulfate Radical, SO_4^-, with Anions, *J.Phys.Chem.* **94**, 8561 - 8567.

Huie, R. E., Shoute, L. C. T. and Neta, P., 1991a, Temperature dependence of the rate constants for reactions of the carbonate radical with organic and inorganic reductants, *Int.J.Chem.Kin.* **23**, 541 - 542.

Huie, R. E., Clifton, C. L., and Neta, P., 1991b, Electron Transfer Reaction Rates and Equilibria of the Carbonate and Sulfate Radical Anions, *Radiat.Phys.Chem.* **38**, 477 - 481.

Jacob, D. J., 1986, Chemistry of OH in Remote Clouds and its Role in the Production of Formic Acid and Peroxymonosulfate, *J.Geophys.Res.* **91**, 9807 - 9826.

Jacob, D. J., Gottlieb, E. W., and Prather, M. J., 1989, Chemistry of a Polluted Cloud Boundary Layer, *J.Geophys.Res.* **94**, 12975 - 13002.

Jacobi, H.-W., 1996, Ph.D. Thesis, Kinetische Untersuchungen und Modellrechnungen zur troposphärischen Chemie von Radikalanionen und Ozon in wäßriger Phase, University-GH-Essen, Germany.

Jacobi, H.-W., Herrmann, H. and Zellner, R., 1996, Kinetic investigation of the Cl_2^- radical in the aqueous phase, in Ph. Mirabel (ed), *Air Pollution Research Report 57: Homogenous and heterogenous chemical Processes in the Troposphere*, 172 - 176, Office for official Publications of the European Communities, Luxembourg.

Jacobi, H.-W., Herrmann, H. and R. Zellner, 1997, A Laser Flash Photolysis Study of the Decay of Cl-Atoms and Cl_2^--Radical Anions in Aqueous Solution at 298 K, *Ber. Bunsenges. Phys. Chem*. **101**, 1909-1913.

Jacobi, H.-W., Wicktor, F., Herrmann, H. and Zellner, R., 1999, A Laser Flash Photolysis Kinetic Study of the Cl_2^--Radical Anion with Oxygenated Hydrocarbons in Aqueous Solution, *Int. J. Chem. Kin.* **31**, 169-181.

Jayson, G. G., Parson, B. J. and Swallow, A. J., 1973a, Same Simple, Highly Reactive, Inorganic Chlorine Derivatives in Aqueous Solution, *J.Chem.Soc.Faraday Trans.* **69**, 1597 - 1607.

Jayson, G. G., Parson, B. J., and Swallow, A. J., 1973b, Oxidation of ferrous ions by per hydroxyl radicals, *J.Chem.Soc.Faraday Trans.* **69**, 236 - 242.

Jiang, P.-Y., Katsumura, Y., Nagaishi, R., Domae, M., Ishikawa, K., Ishigure, K. and Yoshida, Y., 1992, Pulse Radiolysis Study of Concentrated Sulfuric Acid Solutions, *J.Chem.Soc.Faraday Trans.* **88**, 1653 - 1658.

Khan, I. and Brimblecombe, P., 1992, Henry's Law Constants of Low Molecular Weight (< 130) Organic Acids, *J.Aerosol Sci.* **23**, Suppl. 1, S897 - S900.

Kirchner, W., Welter, F., Bongartz, A., Kames, J., Schweighoefer, S. and Schurath, U., 1990, Trace Gas Exchange at the Air/Water Interface: Measurements of Mass Accommodation Coefficients, *J. Atm. Chem.* **10**, 427-449.

Kläning, U. K. and Wolff, T., 1985, Laser flash photolysis of HClO, ClO^-, HBrO and BrO^- in aqueous solution, Reactions of Cl- and Br-atoms, *Ber. Bunsenges. Phys. Chem*., **89**, 243-245.

Kläning, U. K., Sehested, K. and Holcman, J., 1985, Standard Gibbs free energy of formation of the hydroxyl radical in aqueous solution; Rate constants for the reaction $ClO_2^- + O_3 \rightleftharpoons O_3^- + ClO_2$, *J. Phys. Chem*., **89**, 760-3.

Kok, G. L., Gitlin, S. N. and Lazrus, A. L., 1986, Kinetics of the Formation and Decom-position of Hydroxymethanesulfonate, *J.Geophys.Res.* **91**, 2801 - 2804.

Kosak-Channing, L. F. and Helz, G. R., 1983, Solubility of Ozone in Aqueous Solutions of 0-0.6 M Ionic Strength at 5-30°C, *Environ.Sci.Technol.* **17**, 145 - 149.

Kozlov, Y. N. and Berdnikov, V. M., 1973, Photodecomposition of hydrogen peroxide in the presence of copper ions. IV. Determinations of rate constants of elementary reactions, *Russ.J.Phys.Chem.* **47**, 338 - 340.

Kuz'min, V. A., 1972, Reactions of the CO_3^- and SiO_3^- Radical Anions, *High Energy Chem.* **6**, 338 - 339.

Lammel, G., Perner, D., and Warneck, P., 1990, Decomposition of Pernitric Acid in Aqueous Solution, *J.Phys.Chem.* **94**, 6141 - 6144.

Laurence, G. S. and Thornton, A. T., 1973, Kinetics of Oxidation of Transition-metal Ions by Halogen Radical Anions. Part III, The Oxidation of Manganese(II) by Dibromide and Dichloride Ions Generated by Flash Photolysis, *J.Chem.Soc.Dalton Trans.*, 1637 - 1644.

Leibrock, E. and Slemr, J., 1996, Determination of Oxygenated Hydrocarbons in Air by GC/MS, in P. M. Borrell, P. Borrell, T. Cvitaš, K. Kelly and W. Seiler (eds), *Proceedings of EUROTRAC Symposium '96: Transport and Transformation of Pollutants in the Troposphere Vol. 1*, 377 - 381, Computational Mechanics Publications, Southampton, UK.

Lelieveld, J. and Crutzen, P. J., 1990, Influences of cloud photochemical processes on tropospheric ozone, *Nature*, **Vol. 343**, 227-233.

Lelieveld, J. and Crutzen, P. J., 1991, The role of clouds in tropospheric photochemistry, *J.Atmos.Chem.* **12**, 229 - 268.

Lind, J. A., Lazrus, A. L. and Kok, G. L., 1987, Aqueous Phase Oxidation of Sulfur(IV) by Hydrogen Peroxide, Methylhydroperoxide and Peroxyacetic acid, *J.Geophys.Res.* **92**, 4171 - 4177.
Lind, J. A. and Kok, G. L., 1994, Correction to „Henry's Law determinations for aqueous solutions of hydrogen peroxide, methylhydroperoxide and peroxyacetic acid, *J.Geophys.Res.* **99**, 21119.
Logager, T., Sehested, K. and Holcman, J., 1993, Rate constants of the equilibrium reactions $SO_4^{-} + HNO_3 \rightleftharpoons HSO_4^{-} + NO_3$ and $SO_4^{-} + NO_3^{-} \rightleftharpoons SO_4^{2-} + NO_3$, *Radiat.Phys.Chem.* **41**, 539 - 543.
Loomis, A. G., 1928, *International Critical Tables Vol. III: Solubilities of Gases in Water*, 255 - 261, McGraw-Hill, New York.
Mackay, D. and Shiu, W. Y., A critical Review of Henry's Law Constants for Chemicals of Environmental Interest, 1981, *J. Phys. Chem. Ref. Data* **10**, No. 4, 1175-1199.
Marsh, A. R. W. and McElroy, W. J., 1985, The dissociation constant and Henry's law constant of HCl in aqueous solution, *Atoms.Environm.* **19**, 1075 - 1080.
Maruthamuthu, P. and Neta, P., 1977, Radiolytic Chain Decomposition of Peroxomonophosphoric and Peroxomonosulphuric Acids, *J.Phys.Chem.* **81**, 937 - 940.
Matthijsen, J., Builtjes P. J. H. and Sedlak, D. L., 1995, Cloud Model Experiments of the Effect of Iron and Copper on Tropospheric Ozone under Marine and Continental Conditions, *Meteorol.Atmos.Phys.* **57**, 43 - 60.
McElroy, W. J. and Waygood, S. J., 1990, Kinetics of the Reactions of the SO_4^{-} Radical with SO_4^{-}, $S_2O_8^{2-}$, H_2O and Fe^{2+}, *J.Chem.Soc.Faraday Trans.* **86**, 2557 - 2564.
McElroy, W. J., 1997, The interactions of gases with aqueous aerosol particles, central Electr., Gen. Board, Part IV.
Merényi, G. and Lind, J., 1994, Reaction Mechanism of Hydrogen Abstraction by the Bromine Atom in Water, *J.Am.Chem.Soc.* **116**, 7872 - 7876.
Mirabel, P., 1996, Investigations of the Uptake Rate of Some Atmospheric Trace Gases, RINOXA Final Report.
Möller, D. and Mauersberger, G., 1992, Cloud Chemistry Effects on Tropospheric Photo-oxidants in Polluted Atmosphere - Model Results, *J. Atmos. Chem*. **14**, 153-165
Möller, D. and Mauersberger, G., 1995, Aqueous Phase Chemical Reaction System used in Cloud Chemistry Modelling, in A. Flossmann, T. Cvitaš, D. Möller and G. Mauersberger (eds), *Clouds: Models and Mechanisms*, 77 - 93, ISS, Garmisch-Partenkirchen, Germany.
National Bureau of Standards, 1971, JANAF Thermodynamic Tables, 2nd ed., *NSDRS-NBS 37*, U. S. Dep. of Commerce, Washington, D. C.
Neta, P. and Huie, R. E., 1986, Rate constants for reactions of NO_3 radicals in aqueous solution, *J.Phys.Chem.* **90**, 4644 - 4648.
Norman, R. O. C., Storey, P. M. and West, P. R., 1970, Electron Spin Resonance Studies. Part XXV. Reactions of the Sulphate Radical Anion with Organic Compounds, *J.Chem.Soc. B*, 1087 - 1095.
Nowacki, P., 1998, Modeling of size-resolved multi-phase chemical processes in clouds under polluted atmospheric conditions. PhD Thesis in preparation, BTU Cottbus.
Olson, T. M. and Hoffmann, M. R., 1989, Hydroxyalkylsulfonate formation: its role as a S(IV) reservoir in atmospheric water droplets, *Atmos.Environm.* **23**, 985 - 997.
O'Sullivan, D. W., Lee, M., Noone, B. C. and Heikes, B. G., 1996, Henry's Law Constant Determinations for Hydrogen Peroxide, Ethyl Hydroperoxide and Peroxyacetic Acid, *J. Phys. Chem.***100**, 3241-3247
Park, J.-Y. and Lee, Y.-N., 1988, Solubility and Decomposition kinetics of nitrous acid in aqueous solution, *J.Phys.Chem.* **92**, 6294 - 6302.
Pick-Kaplan, M. and Rabani, J., 1976, Pulse radiolytic studies of aqueous $Mn(ClO_4)_2$ solutions, *J.Phys.Chem.* **80**, 1840 - 1843.
von Piechowski, M., Nauser, T., Hoignè, J. and Bühler, R. E., 1993, O_2^{-} Decay Catalysed by Cu^{2+} and Cu^{+} Ions in Aqueous Solutions: A Pulse Radiolysis Study for Atmospheric Chemistry, *Ber.Bunsenges.Phys. Chem.* **97**, 762 - 771.
Pikaev, A. K., Sibirskaya, G. K., Shirshov, E. M., Glazunov, P. Y. and Spitsyn, V. I., 1974, Pulsed radiolysis of concentrated aqueous solutions of nitric acid, *Dokl.Phys.Chem., Proc.Acad.Sci.USSR* **215**, 328 - 331.
Ponche, J. L., George C. and Mirabel, P., 1993, Mass Transfer at the Air/Water Interface: Mass Accommodation Coefficients of SO_2, HNO_3, NO_2 and NH_3, *J. Atm. Chem.* **16**, 1-21.
Raabe, G., 1996, *Eine laserphotolytische Studie zur Kinetik der Reaktionen des NO_3-Radikals in wäßriger Lösung*, Cuvillier, Göttingen, Germany.
Rafi, A. and Sutton, H. C., 1965, Radiolysis of aerted solutions of potassium bromide, *Trans.Faraday Soc.* **61**, 877 - 890.
Redlich, O., 1946, The dissociation of strong electrolytes, *Chem.Rev.*,**39**, 333 - 356.
Redlich, O. and Hood, G. C., 1957, Ionic Interaction, Dissociation and Molecular Structure, *Faraday Discuss.* **24**, 87 - 93.

Reese, A., 1992, Diploma Thesis, Untersuchungen zur Spektroskopie und Kinetik der Radikalanionen SO_x^- (x = 3, 4, 5) in wäßriger Lösung, University Essen, Germany.
Reese, A., 1997, Ph.D. Thesis, UV/VIS-spektrometrische und kinetische Untersuchungen von Radikalen und Radikalanionen in wäßriger Lösung, University Essen, Germany.
Reese, A., Herrmann, H. and Zellner, R., 1997, Kinetics and spectroscopy of organic peroxyl radicals (RO_2) in aqueous solution, in P. M. Borrell, P. Borrell, T. Cvitaš, K. Kelly and W. Seiler (eds), *Proceedings of EUROTRAC Symposium '96: Transport and Transformation of Pollutants in the Troposphere Vol. 1*, 377 - 381, Computational Mechanics Publications, Southampton, UK.
Reese, A., Herrmann, H.and Zellner, R., 1999, Kinetic and Spectroscopic Investigations of the Br_2^- Radical in Aqueous Solution, in: Proceedings of the EUROTRAC-2 '98 symposium, eds: P.M.Borrell and P.Borrell, WIT press, Southampton, 714-718.
Rettich, T. R., 1978, Some photochemical reactions of aqueous nitric acid, *Diss. Abstr. Int. B* **38**, 5968.
Röth, E.-P., 1997, submitted to *J.Geophys.Res.*
Rohrer, F. and Brüning, D., 1992, Surface NO and NO2 Mixing Ratios Measured between 30°N and 30°S in the Atlantic Region, *J. Atm. Chem*. **15**, 253-267.
Rudich, Y., Talukdar, R. K., Ravishankara, A. R., and Fox, R. W., 1996, Reactive Uptake of NO_3 on pure Water and Ionic Solutions, *J.Geophys.Res.* **101**, 21023 - 21031.
Ruggaber, A., Dlugi, R., Bott, A., Forkel, R., Herrmann, H., and Jacobi, H.-W., 1997, Modelling of radiation quantities and photolysis frequencies in the aqueous phase in the troposphere, *Atmos.Environm.***31**, 3137 - 3150.
Rush, J. D. and Bielski, B. H. J., 1985, Pulse radiolytic studies of the reactions of HO_2/O_2^- with Fe(II)/FE(III) ions. The reactivity of HO_2/O_2^- with ferric ions and its implication on the occurrence of the Haber-Weiss-reaction, **89**, 5062 - 5066.
Sander, R. and Crutzen, P. J., 1996, Model study indicating halogen activation and ozone destruction in polluted air masses transported to the sea, *J.Geophys.Res.* **101**, 9121 - 9138.
Saxena, P. and Hildemann, L. M., 1996, Water-Soluble Organics in Atmospheric Particles: A Critical Review of the Literature and Application of Thermodynamics to Identify Candidate Compounds, *J. Atmos. Chem*. **24**, 57-109.
Schuchmann, M. N. and von Sonntag, C., 1988, The rapid hydration of the acetyl radical. A pulse radiolysis study of acetaldehyde in aqueous solution, *J. Am. Soc.* **110**, 5698-5701.
Schwartz, A., 1986, Mass transport considerations pertinent to aqueous phase reactions of gases in liquid water clouds, in W. Jaeschke (Ed.) *Chemistry of Multiphase Atmospheric Systems*.
Schwartz, S. E. and White, W. H., 1983 Kinetics of reactive dissollution of nitrogen oxides into aqueous solution, *Adv. Environm. Sci. Technol*. **12**, 1-115.
Schwarz, H. A. and Bielski, B. H. J., 1986, Reactions of HO_2 and O_2^- with Iodine and Bromine and the I_2^- and I Atom Reduction Potentials, *J. Phys. Chem.* **90**, 1445-48.
Schweitzer, F., Magi, L., George, C. and Mirabel, P., 1998, Uptake Rate Measurements of Methanesulfonic Acid and Glyoxal by Aqueous Droplets, *J. Phys. Chem.* **102**, 593.
Sedlak, D. L. and Hoigné, J., 1993, The Role of Copper and Oxalate in the Redox Cycling of Iron in Atmospheric Waters, *Atmos. Environm.* **27A**, 2173 - 2185.
Sehested, K., Holcman, J. and Hart, E. J., 1983, *J.Phys.Chem.* **87**, 1951 - 1954.
Sehested, K., Logager, T., Holcman, J. and Nielsen, O. J., 1994, Formation and reactions of the NO_3 radical in aqueous solution, in P. M. Borrell, P. Borrell, T. Cvitaš and W. Seiler (eds), *Proceedings of EUROTRAC Symposium '94: Transport and Transformation of Pollutants in the Troposphere*, 999 - 1004, SPB Academic Publishing, The Hague, NL.
Shoute, L. C. T., Alfassi, Z. B., Neta, P. and Huie, R. E., 1991, Temperature Dependence of the rate constants for reaction of dihalide and azide radicals with inorganic reductances, *J. Phys. Chem.* **95**, 3238-42.
Sirs, J. A., 1958, Electronic Stopped Flow Measurements of Rapid Reactions in Solution. Part2. Glass Electrode pH Measurements, *Trans.Faraday Soc.* **54**, 207 - 212.
von Sonntag, C., 1987, The Chemical Basis of Radiation Biology, Taylor & Francis.
Stanbury, D. M., 1989, Reduction potentials involving inorganic free radicals in aqueous solution, *Adv.Inorg.Chem.* **33**, 69 - 138.
Stockwell, W. R., Middleton, P., Chang, J. S., and Tang, X., 1990, The Second Generation Regional Acid Deposition Model. Chemical Mechanism for Regional Air Qualitiy Modeling, *J.Geophys.Res.* **95**, 16343 - 16367.
Stockwell, W. R., Kirchner, F., Kuhn, M. and Seefeld, S., 1997, A new mechanism for regional atmospheric chemistry modeling, *J. Geophys. Res*. D22, **102**, 25847-25879.
Tang, Y., Thorn, R. P., Mauldin III., R. L., and Wine, P. H., 1988, Kinetics and Spectroscopy of the SO_4^- Radical in Aqueous Solution, *J.Photochem.Photobiol.* **A44**, 243 - 258.
Thomas, J. K., 1965, Rates of reaction of the hydroxyl radical, *Trans.Faraday Soc.* **61**, 702 - 707.

Thomas, K., Volz-Thomas, A., Mihelcic, D., Smit, H. G. J. and Kley D., 1998, On the Exchange of NO_3 Radicals with Aqueous Solutions: Solubility and Sticking Coefficient, *J. Atm. Chem.* **29**, 17-43.

Thornton, A. T. and Laurence, G. S., 1973, Kinetics of oxidation of transition-metal ions by halogen radical anions. I. The oxidation of iron (II) by dibromide and dichloride ions generated by flash photolysis, *J.Chem.Soc.Dalton Trans.*, 804 - 813.

Wagner, I. and Strehlow, H., 1987, On the Flash Photolysis of Bromide Ions in Aqueous Solution, *Ber.Bunsenges.Phys.Chem.* **91**, 1317 - 1321.

Wagner, I., Strehlow, H. and Busse, G., 1980, Flash Photolysis of Nitrate Ions in Aqueous Solution, *Z.Phys.Chem.* **123**, 1 - 33.

Walling, C. and Goosen, A., 1973, Mechanism of the Ferric Ion Catalyzed Decomposition of Hydrogen Peroxide. Effect of Organic Substrates, J. Am. Soc., 95:9, 2987-2991.

Walling, C., 1975, Fenton's Reagent Revisited, *Acc.Chem.Res.* **8**, 125 - 131.

Walcek, C. J., Yuan, H. H. and Stockwell, W. R., 1997, The influence of aqueous-phase chemical reactions on ozone formation in polluted and nonpolluted clouds, *Atmos. Env.* **31**, 8, 1221-1237

Wang, T. X. and Margerum, D. W., 1994, Kinetics of Reversible Chlorine Hydrolysis: Temperature Dependence and General-Acid/Base-Assisted Mechanisms, *Inorg.Chem.* **33**, 1050 - 1055.

Warneck, P. (ed.), 1996, *Heterogeneous and Liquid-Phase Processes*, Springer Verlag, Berlin, Germany.

Warneck, P. and Wurzinger, C., 1988, Product Quantum Yields for the 305 nm Photodecomposition of NO_3^- in Aqueous Solution, *J.Phys.Chem.* **92**, 6278 - 6283.

Weinstein-Lloyd, J. and Schwartz, S. E., 1991, Low-intensity radiolysis study of free-radical reactions in cloudwater: H_2O_2 production and destruction, *Environ.Sci.Technol.* **25**, 791 - 800.

Welch, M. J., Lifton, J.F., and Seck, J.A., 1969, Tracer Studies with Radiaoactive Oxygen-15. Exchange between Carbon Dioxide and Water, *J.Phys.Chem.* **73**, 3351 - 3356.

Weschler, C. J., Mandich, M. L. and Graedel, T. E., 1986, Speciation, Photosensitivity and Reactions of Transition Metal Ions in Atmosheric Droplets, *J. Geophys. Res.* **91**, 5189-5204.

Wicktor, F., Reese, A., Herrmann, H. and Zellner, R., 1996, Lasergestützte kinetische und spektroskopische Untersuchungen des Br_2^--Radikalanions in wäßriger Lösung, GDCh Umwelt und Chemie, Umwelttagung 1996.

Wilhelm, E., Battino, R., and Wilcock, R. J., 1977, Low-Pressure Solubility of Gases in Liquid Water, *Chem.Rev.* **77**, 219 - 262.

Zehavi, D. and Rabani, J., 1972, The Oxidation of Aqueous Bromide Ions by Hydroxyl Radicals. A Pulse Radiolysis Investigation, *J.Phys.Chem.* **76**, 312 - 319.

Zellner, R., Exner, M. and Herrmann, H., 1990, Absolute OH Quantum Yields in the Laser Photolysis of Nitrate, Nitrite and Dissolved H_2O_2 at 308 and 351 nm in the Temperature Range of 278-353 K, *J. Atm. Chemistr.* **10**, 411-25.

Zellner, R., Herrmann, H., Exner, M., Jacobi, H.-W., Raabe, G. and Reese, A., 1994, Final report *„Bildung und Reaktionen von Oxidantien in flüssiger Phase"*, University-GH-Essen, Förderkennzeichen FK 07EU7801.

Zellner, R. and Herrmann, H., 1995, Free Radical Chemistry of the Aqueous Atmospheric Phase, in R. J. H. Clark and R. E. Hester (eds), *Advances in Spectroscopy, Vol. 24, Spectroscopy in Environmental Science*, 381 - 451, Wiley, London.

Zellner, R., Herrmann, H., Exner, M., Jacobi, H.-W., Raabe, G. and Reese, A., 1996, Formation and Reactions of Oxidants in the Aqueous Phase, in P. Warneck (ed), *Heterogeneous and Liquid Phase Processes*, 146 - 152, Springer, Berlin.

Ziajka, J., Beer, F. and Warneck, P., 1994, Iron-Catalysed Oxidation of Bisulphite Aqueous Solution: Evidence for a Free Radical Chain Mechanism, *Atmos.Environm.* **28**, 2549 - 2552.

Zimmermann, J. and Poppe, D., 1996, A supplement for the RADM2 chemical mechanism: the photooxidation of isoprene, *Atmos. Environm.* **30**, 1255-1269.