LABORATORY NOTEBOOK

GEOSCIENCES & ENGINEEING DIVISION

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Surface Complexation modeling Approaches to Simulate Actinide Sorption

Project No. 14002.01.354 – Radionuclide Release Rates and Solubility Limits
08/05/2009

8/5/2009 DRT

David R. Turner (DRT)

The information in this scientific notebook is intended to support the staff review of the DOE approach to simulating transport through the engineered barrier system as presented in the 2008 safety analysis report (SAR) and the underlying references. Specifically, the information contained in this notebook is focused on surface complexation modeling (SCM) approaches used to simulate actinide sorption.

DRT

Anticipated software to be used includes:

PHREEQCi, Version 2.15.: This software and the necessary SCM modules were validated in accordance with TOP-018 on 12/11/2008. Additional modules will be validated on an "as needed" basis. Thermodynamic data are anticipated to be based on the Nuclear Energy Agency (NEA) thermodynamic database projects as referenced in the DOE SAR.

DRT 8/12/2009

Recorded by:	Date	Verified by:	Date

8/12/2004

DIGITIZING NEPTUNIUM AND PLUTONIUM SORPTION DATA

As a check for the reported ranges in neptunium and plutonium sorption on iron (hydr)oxides, available experimental data for sorption as a function of geochemistry were identified and digitized (see references listed below). These results, usually reported as percent sorbed, were then converted to sorption coefficients (Kd in mL/g) for more ready comparison with the values reported by DOE in the SAR. As can be seen from the references, there is generally much more information available on neptunium sorption on Fe-(hydr)oxides. Only two studies, both from 1985, present sorption results for plutonium on Fe-(hydr)oxides.

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8/12/2008

PROCEDURE FOR CAPTURING DATA POINTS FROM GRAPH IMAGES

By: Deborah J. Waiting, Research Technologist

Software used:

- Seiko Epson Expression 10000 XL scanner & software
- Adobe Illustrator, v. 10.0.3
- ESRI ArcInfo Desktop v. 9.0.0 (Limited validation 2/22/2008)
- ESRI ArcGIS Desktop v. 9.0 (Limited validation 5/24/2005)
- ESRI ArcView v. 3.3 (Limited validation 7/23/20008)
- Microsoft Excel 2003 SP3

Each graph image was scanned from a copy of the original material using Epson Expression 10000 XL scanner to create individual tiff format image of the graph. The scanned tiff graph images were opened in Adobe Illustrator to straighten the image if tilted during copying of original material, and to add crossing lines aligned to the axes to create interior points to aid in registration of the graph. ArcInfo was used to create a grid with assigned coordinate points that correspond to points taken from the x and y axes of the grid image. The graph image was registered to the grid using ArcGIS, creating a world file that assigns the coordinates from the grid to the graph image. The registration of the image to the grid was checked in ArcView and random points on the image were verified with the grid. A point shapefile containing the x and y coordinates for each point was created in ArcView for each data series on the graph. Point coordinates for the graph data series were transferred to a Microsoft Excel worksheet for analysis.

("Y_COORD" numbers are for digitizing grid)

Girvin Figure 2a - Open Circles = 4.5×10^{-13}M

Cs=0.01 M Fe=0.889 g/L

Asp(m2/g)= 600

X_COORD pH	Y_COORD	% Adsorbed	Kd (mL/g)	log Kd (mL	log Ka (mL/m2)
4.03	0.13041	1.30	14.9	1.172	-1.606
5.03	1.36165	13.62	177.4	2.249	-0.529
5.47	3.72030	37.20	666.8	2.824	0.046
5.96	7.26569	72.66	2990.7	3.476	0.698
6.69	9.75875	97.59	45527.0	4.658	1.880
7.73	9.92103	99.21	141396.0	5.150	2.372

Girvin Figure 2a - Open Triangles = 4.7×10^{-12}M

Cs=0.01 M Fe=0.889 g/L

Asp(m2/g)= 600

X_COORD pH	Y_COORD	% Adsorbed	Kd	log Kd	log Ka (mL/m2)
4.02	0.44193	4.42	52.0	1.716	-1.062
5.04	1.10947	11.09	140.5	2.148	-0.631
5.15	2.29621	22.96	335.5	2.526	-0.253
4.15	0.10074	1.01	11.5	1.059	-1.719
5.47	3.89831	38.98	719.1	2.857	0.079
5.58	4.16533	41.65	803.5	2.905	0.127
5.99	7.05801	70.58	2700.1	3.431	0.653
6.14	7.48821	74.88	3355.3	3.526	0.748
6.72	9.40183	94.02	17690.1	4.248	1.470
7.06	9.65401	96.54	31404.1	4.497	1.719
8.65	9.86169	98.62	80249.1	4.904	2.126

Girvin Figure 2a - Open Squares = 4.5×10^{-11}M

Cs=0.01 M Fe=0.889 g/L

Asp(m2/g)= 600

X_COORD pH	Y_COORD	% Adsorbed	Kd	log Kd	log Ka (mL/m2)
4.03	0.29359	2.94	34.0	1.532	-1.246
4.94	1.37649	13.76	179.7	2.254	-0.524
5.46	3.49779	34.98	605.4	2.782	0.004
5.87	6.07895	60.79	1744.9	3.242	0.464
6.87	9.63918	96.39	30067.1	4.478	1.700
7.62	9.87653	98.77	90029.6	4.954	2.176
8.97	9.87653	98.77	90029.6	4.954	2.176

Girvin Figure 2b - Open Circles

Np(tot)=4.7E-12M; Cs=0.01 M Fe=0.889 g/L

Asp(m2/g)= 600

X_COORD pH	Y_COORD	% Adsorbed	Kd	log Kd	log Ka (mL/m2)
4.12	0.08591	0.86	9.8	0.989	-1.789
5.12	2.42972	24.30	361.2	2.558	-0.220
5.67	5.08506	50.85	1164.4	3.066	0.288
6.11	7.50304	75.03	3382.0	3.529	0.751
7.10	9.63918	96.39	30067.1	4.478	1.700

Girvin Figure 2b - Open Triangles

Np(tot)=4.7E-12M; Cs=0.0037M=0.329 g/L

Asp(m2/g)= 600

X_COORD pH	Y_COORD	% Adsorbed	Kd	log Kd	log Ka (mL/m2)
4.02	0.44193	4.42	140.6	2.148	-0.630
5.04	1.10947	11.09	379.5	2.579	-0.199
5.15	2.29621	22.96	906.5	2.957	0.179
4.15	0.10074	1.01	31.0	1.491	-1.287
5.47	3.89831	38.98	1943.1	3.288	0.510
5.58	4.16533	41.65	2171.2	3.337	0.559
5.99	7.05801	70.58	7296.4	3.863	1.085
6.14	7.48821	74.88	9067.0	3.957	1.179
6.72	9.40183	94.02	47803.1	4.679	1.901
7.06	9.65401	96.54	84861.8	4.929	2.151
8.65	9.86169	98.62	216853.3	5.336	2.558

Girvin Figure 2b - Open Squares

Np(tot)=4.7E-12M; Cs=0.001 M Fe=0.0889 g/L

Asp(m2/g)= 600

X_COORD pH	Y_COORD	% Adsorbed	Kd	log Kd	log Ka (mL/m2)
4.03	0.14524	1.45	165.9	2.220	-0.558
4.08	0.38259	3.83	447.7	2.651	-0.127
5.13	0.64961	6.50	781.9	2.893	0.115
5.96	2.07370	20.74	2944.5	3.469	0.691
6.62	4.55102	45.51	9400.2	3.973	1.195
6.94	7.05801	70.58	27001.2	4.431	1.653
7.92	9.14965	91.50	121101.4	5.083	2.305
8.23	9.57984	95.80	256617.4	5.409	2.631
8.97	9.77269	97.73	483880.5	5.685	2.907

Girvin Figure 3 - Open Circles = Measured Values

("Y_COORD" numbers are for digitizing grid)

X_COORD pH	Y_COORD	Log $[C_T]$(M)	
4.11914	-5.02266	-5.02	-4.42
4.71176	-4.68812	-4.69	
5.15144	-4.84105	-4.84	
5.51465	-4.98443	-4.98	
5.87787	-4.71680	-4.72	
6.24108	-4.47784	-4.48	
6.50872	-4.49696	-4.50	
6.71900	-4.44916	-4.45	
7.12045	-4.41093	-4.41	
7.46455	-4.17197	-4.17	
7.66527	-3.98081	-3.98	
8.07353	-4.08077	-4.08	
8.40126	-3.95213	-3.95	
8.98431	-4.16242	-4.16	
9.31885	-3.82788	-3.83	

Neptunium data pts - GIRVIN (1991)

8/12/2009

Project No.

Date

8/12/2009
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Herberling Figure 4 - Open Diamonds = pH 6.0 ("X_COORD" & "Y_COORD" numbers are for digitizing grid)			
X_COORD	**c [mol/L]**	Y_COORD	**q [mol/g]**
-6.67851	-6.68	-8.00901	-8.01
-6.20867	-6.21	-7.69166	-7.69
-5.85010	-5.85	-7.49383	-7.49
-5.51214	-5.51	-7.28775	-7.29
-5.07114	-5.07	-7.03222	-7.03
-4.55184	-4.55	-6.74784	-6.75

Herberling Figure 4 - Open Triangles = pH 7.2 ("X_COORD" & "Y_COORD" numbers are for digitizing grid)			
X_COORD	**c [mol/L]**	Y_COORD	**q [mol/g]**
-6.78155	-6.78	-7.91421	-7.91
-6.27049	-6.27	-7.61335	-7.61
-5.92429	-5.92	-7.35782	-7.36
-5.53275	-5.53	-7.23005	-7.23
-5.07527	-5.08	-6.99925	-7.00
-4.56008	-4.56	-6.71487	-6.71

Herberling Figure 4 - Open Circles = pH 8.3 ("X_COORD" & "Y_COORD" numbers are for digitizing grid)			
X_COORD	**c [mol/L]**	Y_COORD	**q [mol/g]**
-6.92580	-6.93	-7.84003	-7.84
-6.33231	-6.33	-7.54740	-7.55
-6.10975	-6.11	-7.41552	-7.42
-5.93253	-5.93	-7.35782	-7.36
-5.71409	-5.71	-7.23830	-7.24
-5.55335	-5.55	-7.18059	-7.18
-5.26073	-5.26	-7.06519	-7.07
-5.08351	-5.08	-6.97452	-6.97
-4.87744	-4.88	-6.90858	-6.91
-4.74555	-4.75	-6.85088	-6.85
-4.56008	-4.56	-6.71487	-6.71
-4.41995	-4.42	-6.67778	-6.68

Herberling Figure 4 - Open Squares = pH 9.4 ("X_COORD" & "Y_COORD" numbers are for digitizing grid)			
X_COORD	**c [mol/L]**	Y_COORD	**q [mol/g]**
-6.76094	-6.76	-7.92658	-7.93
-6.32819	-6.33	-7.55153	-7.55
-5.88307	-5.88	-7.42788	-7.43
-5.53687	-5.54	-7.21357	-7.21
-5.08351	-5.08	-6.99101	-6.99
-4.56008	-4.56	-6.69838	-6.70

Neptunium data pts - HEBERLING (2008)

8/12/2009

DRM

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Jerden Figure 1a - Open Squares = Np+U 4 hrs
("Y COORD" numbers are for digitizing grid)

X COORD pH	Y COORD	Kd (mL/g ~ (mol/kg)/(mol/kg)
3.51	1.03935	10.95
5.00	2.28690	193.60
6.60	3.30762	2030.58
8.91	4.72907	53588.30

Jerden Figure 1a - Closed Squares = Np 4 hrs
("Y COORD" numbers are for digitizing grid)

X COORD pH	Y COORD	Kd (mL/g ~ (mol/kg)/(mol/kg)
5.01	2.62714	423.78
6.60	3.68567	4849.20
8.91	4.94833	88783.04

Jerden Figure 1a - Open Circles = Np+U 6 days
("Y COORD" numbers are for digitizing grid)

X COORD pH	Y COORD	Kd (mL/g ~ (mol/kg)/(mol/kg)
5.00	2.17349	149.10
6.60	3.50420	3193.01
8.81	4.75175	56461.19

Jerden Figure 1a - Closed Circles = No 6 days
("Y COORD" numbers are for digitizing grid)

X COORD pH	Y COORD	Kd (mL/g ~ (mol/kg)/(mol/kg)
3.50	1.04692	11.14
5.01	2.60446	402.22
6.61	3.78396	6080.79
8.81	5.09950	125762.16

Jerden Figure 1a - Open Triangles = Np+U 24 days
("Y COORD" numbers are for digitizing grid)

X COORD pH	Y COORD	Kd (mL/g ~ (mol/kg) (mol/kg)
3.50	1.00911	10.21
5.00	2.25666	180.58
6.61	3.77640	5975.85
8.80	4.37371	23643.40

Jerden Figure 1b - Open Squares = Np+U 4 hrs
("Y COORD" numbers are for digitizing grid)

X COORD pH	Y COORD	Np in sol(moles/kg)(1.0E+)
3.51	-6.20079	6.30E-07
5.00	-6.20790	6.20E-07
6.60	-6.59836	2.52E-07
8.92	-7.00505	9.88E-08

Jerden Figure 1b - Closed Squares = Np 4 hrs
("Y COORD" numbers are for digitizing grid)

X COORD pH	Y COORD	Np in sol(moles/kg)(1.0E+)
6.60	-6.89594	1.27E-07
8.92	-7.01497	9.66E-08

Jerden Figure 1b - Open Circles = Np+U 6 days
("Y COORD" numbers are for digitizing grid)

X COORD pH	Y COORD	Np in sol(moles/kg)(1.0E+)
3.51	-6.16191	6.89E-07
5.00	-6.18175	6.58E-07
6.61	-6.74715	1.79E-07

Jerden Figure 1b - Closed Circles = No 6 days
("Y COORD" numbers are for digitizing grid)

X COORD pH	Y COORD	Np in sol(moles/kg)(1.0E+)
3.50	-6.22142	6.01E-07
4.99	-6.22142	6.01E-07
6.60	-6.98521	1.03E-07
8.81	-7.01049	9.76E-08

Jerden Figure 1b - Open Triangles = Np+U 24 days
("Y COORD" numbers are for digitizing grid)

X COORD pH	Y COORD	Np in sol(moles/kg)(1.0E+)
3.50	-6.13215	7.38E-07
5.01	-6.19167	6.43E-07
6.61	-7.02489	9.44E-08

Neptunium data pts - JERDEN (2007)

Jerden Figure 1a - Closed Triangles = Np 24 days
("Y COORD" numbers are for digitizing grid)

X COORD pH	Y COORD	Kd (mL/g ~ (mol/kg)/(mol/kg)
3.71	1.00155	10.04
5.10	2.60446	402.22
6.82	3.88981	7759.08
8.80	4.71395	51754.72

Jerden Figure 1a - Open Diamonds = Np+U 103 days
("Y COORD" numbers are for digitizing grid)

X COORD pH	Y COORD	Kd (mL/g ~ (mol/kg)/(mol/kg)
5.15	2.16593	146.53
6.30	3.54201	3483.45
7.03	4.11664	13080.97
8.00	4.13932	13782.25

Jerden Figure 1a - Closed Diamonds = Np 103 days
("Y COORD" numbers are for digitizing grid)

X COORD pH	Y COORD	Kd (mL/g ~ (mol/kg)/(mol/kg)
5.94	3.33787	2177.06
6.46	3.80664	6406.78
7.03	4.21493	16403.25
8.21	4.16956	14776.11

Jerden Figure 1a - "+" = GW Np+U 103 days
("Y COORD" numbers are for digitizing grid)

X COORD pH	Y COORD	Kd (mL/g ~ (mol/kg)/(mol/kg)
8.09	5.07687	119363.06
8.11	5.00126	100290.55

Jerden Figure 1a - "X" = GW Np 103 days
("Y COORD" numbers are for digitizing grid)

X COORD pH	Y COORD	Kd (mL/g ~ (mol/kg)/(mol/kg)
8.03	5.21297	163293.91
8.08	5.16004	144557.29

Jerden Figure 1b - Closed Triangles = Np 24 days
("Y COORD" numbers are for digitizing grid)

X COORD pH	Y COORD	Np in sol(moles/kg)(1.0E+)
3.70	-6.20159	6.29E-07
5.11	-6.25118	5.61E-07
6.80	-7.02489	9.44E-08
8.82	-7.02489	9.44E-08

Jerden Figure 1b - Open Diamonds = Np+U 103 days
("Y COORD" numbers are for digitizing grid)

X COORD pH	Y COORD	Np in sol(moles/kg)(1.0E+)
3.51	-5.03111	9.31E-06
5.16	-5.19974	6.31E-06
6.31	-5.75522	1.76E-06
7.03	-6.27102	5.36E-07
8.00	-6.29086	5.12E-07

Jerden Figure 1b - Closed Diamonds = Np 103 days
("Y COORD" numbers are for digitizing grid)

X COORD pH	Y COORD	Np in sol(moles/kg)(1.0E+)
3.50	-5.08071	8.30E-06
5.93	-5.57667	2.65E-06
6.47	-6.01312	9.70E-07
7.03	-6.30078	5.00E-07
8.21	-6.28094	5.24E-07

Jerden Figure 1b - "+" = GW Np+U 103 days
("Y COORD" numbers are for digitizing grid)

X COORD pH	Y COORD	Np in sol(moles/kg)(1.0E+)
8.09	-6.69755	2.01E-07
8.10	-6.64795	2.25E-07

Jerden Figure 1b - "X" = GW Np 103 days
("Y COORD" numbers are for digitizing grid)

X COORD pH	Y COORD	Np in sol(moles/kg)(1.0E+)
3.50	-5.08071	8.30E-06
8.07	-6.64795	2.25E-07
8.03	-6.70747	1.96E-07

Neptunium data pts - JERDEN (2007)

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("Y COORD" numbers are for digitizing grid)

Khasanova Figure 1 - Closed Squares = c(∂ - Fe_2O_3)=1.12 g/l

alpha-Hematite; Cs=1.12 g/L; Np(tot)=6E-7 M

Asp (m2/g) = 6.4

X_COORD pH	Y_COORD	Np(V) sorption, %	Kd	log Kd	log Ka (mL/m2)
3.85	0.19085	1.91	17.4	1.240	0.434
6.27	1.38575	13.66	141.2	2.150	1.344
6.27	1.94444	19.44	215.5	2.333	1.527
6.58	1.57618	15.78	187.1	2.223	1.417
6.67	1.06765	10.68	106.7	2.028	1.222
6.81	3.03166	30.32	388.4	2.589	1.783
7.42	3.17194	31.72	414.8	2.618	1.812
7.49	5.53928	55.39	1106.7	3.045	2.239
7.83	8.73080	87.31	6141.9	3.788	2.982
8.53	9.50238	95.02	17049.7	4.232	3.426
9.86	9.32702	93.27	12374.4	4.093	3.286
9.88	8.73080	87.31	6141.9	3.788	2.982
6.32	0.69939	6.99	67.1	1.827	1.021
6.42	0.64679	6.47	61.7	1.791	0.984

Khasanova Figure 1 - Open Circles = c(∂ - Fe_2O_3)=0.71 g/l

alpha-Hematite; Cs=0.71 g/L; Np(tot)=6E-7 M

Asp (m2/g) = 6.4

X_COORD pH	Y_COORD	Np(V) sorption, %	Kd	log Kd	log Ka (mL/m2)
4.51	0.38375	3.84	56.2	1.750	0.944
5.91	0.48896	4.89	72.4	1.860	1.054
6.41	1.99704	19.97	351.5	2.546	1.740
6.77	2.48805	24.88	486.5	2.689	1.863
7.41	2.92644	29.26	582.7	2.765	1.959
7.63	3.64541	36.45	808.0	2.907	2.101
8.12	5.15349	51.53	1497.7	3.175	2.369
8.83	6.50375	65.04	2620.0	3.418	2.612

Khasanova Figure 1 - Closed Triangles = c(∂ - Fe_2O_3)=0.44 g/l

alpha-Hematite; Cs=0.44 g/L; Np(tot)=6E-7 M

Asp (m2/g) = 6.4

X_COORD pH	Y_COORD	Np(V) sorption, %	Kd	log Kd	log Ka (mL/m2)
4.16	-0.10726	-1.07	-24.1	#NUM!	#NUM!
2.65	0.19085	1.91	44.2	1.646	0.839
3.95	0.03303	0.33	7.5	0.877	0.071
5.16	0.26100	2.61	60.9	1.785	0.978
5.20	0.03303	0.33	7.5	0.877	0.071
6.28	0.66432	6.64	161.7	2.209	1.403
6.70	0.40128	4.01	95.0	1.978	1.172
7.60	1.47097	14.71	392.0	2.593	1.787
8.51	2.40037	24.00	717.8	2.856	2.050
8.65	2.76862	27.69	870.1	2.940	2.133

Khasanova Figure 1 - Open Diamonds = c(∂-FeOOH)=0.22 g/l

alpha-Goethite; Cs=0.22 g/L; Np(tot)=6E-7 M

Asp (m2/g) = 41.7

X_COORD pH	Y_COORD	Np(V) sorption, %	Kd	log Kd	log Ka (mL/m2)
2.76	-0.01958	-0.20	-8.9	#NUM!	#NUM!
2.32	0.29607	2.96	138.7	2.142	0.522
3.44	0.19085	1.91	88.4	1.947	0.327
4.09	0.82214	8.22	407.2	2.610	0.990
5.04	1.68140	16.81	918.8	2.963	1.343
5.11	1.54111	15.41	828.1	2.918	1.298
5.72	3.78570	37.86	2769.1	3.442	1.822
6.42	6.73172	67.32	9362.3	3.971	2.351
6.55	7.71373	77.14	15336.1	4.186	2.566
8.35	8.99384	89.94	40630.8	4.609	2.989
10.04	9.51992	95.20	90135.7	4.955	3.335

Khasanova Figure 2 - Closed Squares = Np(V) in absence of HA

alpha-Goethite; Cs=0.22 g/L; Np(tot)=5.8E-7 M

Asp (m2/g) = 41.7

X_COORD pH	Y_COORD	Np sorption, %	Kd	log Kd	log Ka (mL/m2)
2.30	0.31360	3.14	147.2	2.168	0.548
3.42	0.22593	2.26	105.1	2.021	0.401
4.07	0.83968	8.40	416.7	2.620	1.000
5.02	1.69894	16.99	930.3	2.969	1.348
5.11	1.54111	15.41	828.1	2.918	1.298
5.70	3.80323	38.03	2789.7	3.446	1.825
6.42	6.69665	66.97	9214.7	3.964	2.344
6.51	7.97676	79.77	17920.8	4.253	2.633
8.33	8.78341	87.83	32818.8	4.516	2.896
10.05	9.48484	94.85	83688.4	4.923	3.303

Khasanova Figure 3 - Closed Squares = Np(V) without HA

alpha-Goethite; Cs=0.22 g/L; Np(tot)=5.8E-7 M

Asp (m2/g) = 41.7

X_COORD pH	Y_COORD	Np/HA sequested from solution, %	Kd	log Kd	log Ka (mL/m2)
2.30	-0.03711	-0.37	-18.8	#NUM!	#NUM!
2.37	-0.03711	-0.37	-18.8	#NUM!	#NUM!
2.74	-0.01958	-0.20	-8.9	#NUM!	#NUM!
2.79	-0.01958	-0.20	-8.9	#NUM!	#NUM!
3.41	0.20839	2.08	96.7	1.986	0.365
4.04	0.68186	6.82	332.6	2.522	0.902
4.30	0.92736	9.27	464.6	2.667	1.047
5.00	1.66386	16.64	907.3	2.958	1.338
5.09	2.38283	23.83	1421.9	3.153	1.533
5.30	4.60988	46.10	3887.5	3.590	1.970
5.91	6.73172	67.32	9362.3	3.971	2.351
6.46	7.38054	73.81	12807.2	4.107	2.487
6.51	7.69619	76.96	15184.7	4.181	2.561
7.32	8.48530	84.85	25463.5	4.406	2.786
7.72	8.99384	89.94	40630.8	4.609	2.989
8.35	9.18673	91.87	51345.6	4.711	3.090
10.07	9.50238	95.02	86798.4	4.939	3.318

Khasanova Figure 4 - Closed Squares = Np(V) without HA

alpha-Hematite; Cs=0.44 g/L; Np(tot)=7.05E-7 M

Asp (m2/g) = 6.4

X_COORD pH	Y_COORD	Np sorption, % by ∂ - Fe_2O_3	Kd	log Kd	log Ka (mL/m2)
2.13	0.36058	3.61	85.0	1.929	1.123
2.64	0.28914	2.89	67.7	1.830	1.024
3.59	0.00340	0.03	0.8	-0.112	-0.918
4.13	0.04422	0.44	10.1	1.004	0.198
5.28	0.06463	0.85	14.8	1.170	0.364
5.68	0.25853	2.59	60.3	1.780	0.974
6.23	0.67694	6.77	165.0	2.218	1.411
6.68	0.80961	8.10	200.2	2.301	1.495
7.31	1.59540	15.95	431.4	2.635	1.829
7.80	2.70776	27.08	843.9	2.926	2.120
8.28	3.20782	32.08	1073.4	3.031	2.225

Khasanova Figure 5 - Closed Squares = Np(V) without HA

alpha-Goethite; Cs=0.22 g/L; Np(tot)=5.8E-7 M

Asp (m2/g) = 41.7

X_COORD pH	Y_COORD	Np sorption, % onto ∂ - FeOOH	Kd	log Kd	log Ka (mL/m2)
2.72	-0.01958	-0.20	-8.9	#NUM!	#NUM!
2.76	-0.01958	-0.20	-8.9	#NUM!	#NUM!
2.32	0.31360	3.14	147.2	2.168	0.548
3.42	0.22593	2.26	105.1	2.021	0.401
4.06	0.83968	8.40	416.7	2.620	1.000
4.30	0.96243	9.62	484.1	2.685	1.065
5.02	1.68140	16.81	918.8	2.963	1.343
5.09	1.55865	15.59	839.3	2.924	1.304
5.39	4.01366	40.14	3047.6	3.484	1.864
5.88	6.76679	67.67	9513.2	3.978	2.358
6.42	7.32794	73.28	12485.6	4.096	2.476
6.48	7.73126	77.31	15489.7	4.190	2.570
7.26	8.15212	81.52	20052.8	4.302	2.682
7.67	8.71327	87.13	30780.2	4.488	2.868
8.30	9.01138	90.11	41432.3	4.617	2.997
10.00	9.53745	95.37	93724.0	4.972	3.354

Neptunium data pts - KHASANOVA (2007)

"Y COORD" numbers are for digitizing grid)

KOHLER Figure 3 - Hematite; Closed Triangles = Experiment (average of digitizing 3(a) and 3(b))
Carbonate adsorption; Cs=5.75 g/l; CO2(tot)=50 uM
Asp(m2/g)= 14.4 % Suspension

X COORD pH	Y COORD	CO2 adsorbed	Kd	log Kd	log Ka (mL/m2)
4.01	3.95551	39.56	113.8	2.056	0.898
4.31	4.63480	46.35	150.2	2.177	1.018
4.74	5.77424	57.74	237.6	2.376	1.218
5.22	7.01594	70.16	408.9	2.612	1.453
5.65	7.69522	76.95	580.7	2.764	1.606
5.80	7.82669	78.27	626.3	2.797	1.638
6.18	8.08964	80.90	736.5	2.867	1.709
6.47	8.03851	80.39	712.7	2.853	1.695
6.61	8.01680	80.17	702.9	2.847	1.689
7.04	7.57105	75.71	542.1	2.734	1.576
7.47	6.54848	65.48	330.0	2.518	1.360

KOHLER Figure 4 - Goethite; Closed Circles = Experiment (average of digitizing 4(a) and 4(b))
Carbonate sorption; Cs=2 g/l; CO2(tot)=55 uM
Asp(m2/g)= 45 % Suspension

X COORD pH	Y COORD	CO2 adsorbed	Kd	log Kd	log Ka (mL/m2)
3.99	2.25365	22.54	145.5	2.163	0.510
4.57	3.26893	32.69	242.8	2.385	0.732
5.10	4.37185	43.72	388.4	2.589	0.936
5.57	5.27756	52.78	556.8	2.747	1.094
6.05	5.57703	55.77	630.5	2.800	1.146
6.49	5.00000	50.00	500.0	2.699	1.046
6.72	4.39376	43.94	391.9	2.593	0.940
6.93	2.90372	29.04	204.6	2.311	0.658
7.20	1.10691	11.07	82.2	1.794	0.141
7.62	1.42099	14.21	82.8	1.918	0.265

KOHLER Figure 6 - Hematite; Open Circles = 0.005M
Cs=1 g/l; No CO2; I=0.005 M NaClO4)
Asp(m2/g)= 14.4

X COORD pH	Y COORD	% Np(V) adsorbed	Kd	log Kd	log Ka (mL/m2)
4.94	-0.03984	-0.40	-4.0	#NUM!	#NUM!
6.01	0.15883	1.59	16.1	1.208	0.050
6.15	1.57291	15.73	186.6	2.271	1.113
6.77	4.12058	41.21	700.8	2.846	1.687
6.81	4.81009	48.10	926.8	2.967	1.809
6.91	4.05046	40.50	680.8	2.833	1.675
7.53	8.59655	85.97	6125.3	3.787	2.629
10.00	9.94050	99.41	167067.2	5.223	4.065

KOHLER Figure 5 - Hematite; Closed Triangles = 0.01M
Cs=1 g/l; No CO2; I=0.01 M NaClO4)
Asp(m2/g)= 14.4

X COORD pH	Y COORD	% Np(V) adsorbed	Kd	log Kd	log Ka (mL/m2)
5.35	-0.01847	-0.16	-1.8	#NUM!	#NUM!
5.67	0.06534	0.65	6.6	0.818	-0.340
5.84	0.24084	2.41	24.7	1.392	0.234
6.27	1.78327	17.83	217.0	2.337	1.178
6.74	3.76999	37.70	605.1	2.782	1.623
7.05	5.81514	58.15	1389.6	3.143	1.985
7.29	6.15405	61.54	1600.1	3.204	2.046
7.98	9.34449	93.44	14255.3	4.154	2.996
9.21	9.92882	99.29	139468.9	5.145	
9.57	9.89376	98.94	93126.5	4.969	

KOHLER Figure 5 - Hematite; Closed Squares = 0.05M
Cs=1 g/l; No CO2; I=0.05 M NaClO4)
Asp(m2/g)= 14.4

X COORD pH	Y COORD	% Np(V) adsorbed	Kd	log Kd	log Ka (mL/m2)
5.01	0.31078	3.11	32.1	1.508	0.348
5.58	0.42782	4.28	44.7	1.650	0.492
6.02	0.39256	3.93	40.9	1.611	0.453
6.52	3.50120	35.01	538.7	2.731	1.573
6.77	4.30757	43.06	756.7	2.879	1.721
7.24	6.24754	62.48	1664.9	3.221	2.063
7.23	6.92537	69.25	2252.4	3.353	2.194
10.23	9.84701	98.47	64363.7	4.809	3.650

KOHLER Figure 6 - Hematite; Closed Diamonds = 0.1M
Cs=1 g/l; No CO2; I=0.1 M NaClO4)
Asp(m2/g)= 14.4

X COORD pH	Y COORD	% Np(V) adsorbed	Kd	log Kd	log Ka (mL/m2)
4.05	-0.03984	-0.40	-4.0	#NUM!	#NUM!
4.59	-0.02815	-0.28	-2.8	#NUM!	#NUM!
4.81	-0.01647	-0.16	-1.6	#NUM!	#NUM!
5.05	-0.00478	-0.05	-0.5	#NUM!	#NUM!
5.79	-0.01647	-0.16	-1.6	#NUM!	#NUM!
6.89	3.32590	33.26	498.3	2.698	1.539
6.62	3.87649	38.76	581.4	2.764	1.606
6.95	4.93985	49.39	975.8	2.989	1.831
7.34	7.15910	71.59	2520.0	3.401	2.243
9.44	9.91713	99.17	119670.9	5.078	3.920

KOHLER Figure 6 - Np(V) on Hematite; Open Circles = 1 g/L; $1.2*10^{-9}$M
Cs=1 g/l; No CO2; I=0.1 M NaClO4; 1.2E-7M
Asp(m2/g)= 14.4

X COORD pH	Y COORD	% Np(V) adsorbed	Kd	log Kd	log Ka (mL/m2)
4.08	0.05867	0.59	5.9	0.771	-0.387
4.63	0.05867	0.59	5.9	0.771	-0.387
4.82	0.05867	0.59	5.9	0.771	-0.387
5.07	0.04413	0.44	4.4	0.647	-0.512
5.33	0.04413	0.44	4.4	0.647	-0.512
5.74	0.37887	3.79	39.4	1.595	0.437
5.81	0.26231	2.62	26.9	1.430	0.272
5.79	0.02958	0.30	3.0	0.472	-0.686
6.71	3.30229	33.02	493.0	2.693	1.535
6.64	3.69047	36.90	582.4	2.765	1.607
6.96	4.90228	49.02	961.7	2.983	1.825
7.37	7.11318	71.13	2464.0	3.392	2.233
7.54	8.55317	85.53	5911.7	3.772	2.613
7.99	9.28044	92.80	12897.4	4.111	2.952
9.45	9.86226	98.62	71600.6	4.855	3.697
9.58	9.78044	97.80	40743.2	4.610	3.452

KOHLER Figure 6 - Np(V) on Hematite; Closed Triangles = 1 g/L; $1.1*10^{-9}$M
Cs=1 g/l; No CO2; I=0.1 M NaClO4; 1.1E-9M
Asp(m2/g)= 14.4

X COORD pH	Y COORD	% Np(V) adsorbed	Kd	log Kd	log Ka (mL/m2)
5.62	0.00049	0.00	0.0	-1.310	-2.468
6.17	0.27685	2.77	28.5	1.454	0.296
6.80	3.88411	38.84	635.1	2.803	1.644
7.12	5.81501	58.15	1280.5	3.107	1.949
7.19	6.29864	62.99	1701.7	3.231	2.073
7.41	6.68045	66.80	2205.6	3.344	2.185
7.83	8.18045	81.80	4436.1	3.647	2.489
7.93	8.42226	84.22	5338.2	3.727	2.569
8.72	9.46953	94.70	17851.2	4.252	3.093
8.94	8.88772	88.88	7990.5	3.903	2.744

KOHLER Figure 6 - Np(V) on Hematite; Closed Squares = 0.1 g/L; $1.2*10^{-9}$M
Cs=0.1 g/l; No CO2; I=0.1 M NaClO4; 1.2E-8M
Asp(m2/g)= 14.4

X COORD pH	Y COORD	% Np(V) adsorbed	Kd	log Kd	log Ka (mL/m2)
6.29	0.01504	0.15	15.1	1.178	0.020
6.87	0.84412	8.44	921.9	2.965	1.808
7.00	0.75685	7.57	818.8	2.913	1.755
7.47	1.54230	15.42	1823.5	3.261	2.103
7.48	2.03884	20.37	2557.8	3.408	2.250
7.70	1.55685	15.57	1843.9	3.266	2.107
7.98	2.34230	23.42	3058.8	3.486	2.327
8.53	3.25865	32.59	4833.8	3.684	2.526
9.31	5.42592	54.26	11862.3	4.074	2.916
9.77	6.08046	60.80	15513.2	4.191	3.032

KOHLER Figure 6 - Np(V) on Hematite; Closed Diamonds = 0.01 g/L; $1.3*10^{-9}$M
Cs=0.01 g/l; No CO2; I=0.1 M NaClO4; 1.3E-8M
Asp(m2/g)= 14.4

X COORD pH	Y COORD	% Np(V) adsorbed	Kd	log Kd	log Ka (mL/m2)
6.93	0.02958	0.30	296.7	2.472	1.314
7.02	0.02958	0.30	296.7	2.472	1.314
7.28	0.49503	4.95	5208.1	3.717	2.558
7.47	0.11685	1.17	1182.3	3.073	1.914
7.81	0.17503	1.75	1781.5	3.251	2.092
8.03	0.10231	1.02	1033.7	3.014	1.856
8.17	0.26231	2.62	2693.8	3.430	2.272
8.72	0.42231	4.22	4409.3	3.644	2.486
8.98	0.40776	4.06	4250.9	3.628	2.470
9.26	0.33503	3.35	3466.4	3.540	2.382

KOHLER Figure 8 - Closed Circles = Goethite 45 m^2/L
Cs=1 g/l; No CO2; I=0.1 M NaClO4; 1.2E-7M
Asp(m2/g)= 45

X COORD pH	Y COORD	% Np(V) adsorbed	Kd	log Kd	log Ka (mL/m2)
3.20	0.31002	3.10	32.0	1.505	-0.148
3.82	0.06915	0.69	7.0	0.843	-0.810
4.00	0.06915	0.69	7.0	0.843	-0.810
4.19	0.06915	0.69	7.0	0.843	-0.810
4.37	0.73154	7.32	78.9	1.897	0.244
4.79	0.57096	5.71	60.6	1.782	0.129
5.21	2.09646	20.96	265.3	2.424	0.770
5.85	8.53247	85.32	1883.9	3.275	1.622
6.23	8.72037	87.20	6814.8	3.833	2.180
6.89	9.82435	98.24	55931.4	4.748	3.094
6.77	10.00501	100.05	-1997008.0	#NUM!	

KOHLER Figure 8 - Closed Squares = Hematite 14 m^2/L
Cs=1 g/l; No CO2; I=0.1 M NaClO4; 1.2E-7M
Asp(m2/g)= 14.4

X COORD pH	Y COORD	% Np(V) adsorbed	Kd	log Kd	log Ka (mL/m2)
4.56	0.04908	0.49	4.9	0.893	-0.465
4.71	0.04908	0.49	4.9	0.893	-0.465
4.93	0.02900	0.29	2.9	0.464	-0.895
5.15	0.02900	0.29	2.9	0.464	-0.895
5.57	0.35016	3.50	36.3	1.560	0.401
5.65	0.02900	0.29	2.9	0.464	-0.895
6.57	3.36103	33.61	506.3	2.704	1.546
6.51	3.76248	37.62	603.2	2.780	1.622
6.82	5.00897	50.07	1002.8	3.001	1.843
7.22	7.21494	72.15	2590.6	3.413	2.255
7.40	8.68022	86.80	6577.0	3.818	2.660
7.86	9.42291	94.23	16328.3	4.213	3.055
9.52	9.92472	99.25	131837.4	5.120	3.962
9.40	10.00501	100.05	-1997008.0	#NUM!	#NUM!

KOHLER Figure 8 - Closed Triangles = Quartz 180 m^2/L
Cs=1 g/l; No CO2; I=0.1 M NaClO4; 1.2E-7M
Asp(m2/g)= 6.0

X COORD pH	Y COORD	% Np(V) adsorbed	Kd	log Kd	log Ka (mL/m2)
7.88	0.33009	3.30	34.1	1.533	0.755
8.38	0.39031	3.90	40.6	1.609	0.831
9.02	0.97241	9.72	107.7	2.032	1.254
9.52	1.49429	14.94	175.7	2.245	1.467
9.69	1.99610	19.96	249.4	2.397	1.619
10.37	2.87929	28.79	404.4	2.607	1.829
12.11	8.19849	81.98	4550.9	3.658	2.880

KOHLER Figure 9 - Hematite - Open Circles = No CO_2 (average digitized 9(a) & 9(b))
Cs=1 g/l; No CO2; I=0.1 M NaClO4; 1.2E-7M
Asp(m2/g)= 14.4 % Np(V) adsorbed

X COORD pH	Y COORD	on 1g/L Hematite	Kd	log Kd	log Ka (mL/m2)
4.55	-0.02519	-0.25	-2.5	#NUM!	#NUM!
5.26	-0.02519	-2.5		#NUM!	#NUM!
5.72	0.21568	2.16	22.0	1.343	0.185
6.64	3.26669	32.67	485.2	2.686	1.528
6.91	4.88854	48.89	956.4	2.981	1.822
7.34	7.10454	71.05	2453.7	3.390	2.231
9.61	9.83439	98.34	59382.8	4.774	3.615

KOHLER Figure 9 - Hematite - Closed Triangles = Atm CO_2 (average digitized 9(a) & 9(b))
Cs=1 g/l; Atm CO2; I=0.1 M NaClO4; 1.2E-7M
Asp(m2/g)= 14.4 % Np(V) adsorbed

X COORD pH	Y COORD	on 1g/L Hematite	Kd	log Kd	log Ka (mL/m2)
4.03	-0.07578	-0.76	-7.5	#NUM!	#NUM!
5.01	-0.06775	-0.68	-6.7	#NUM!	#NUM!
5.73	-0.10388	-1.04	-10.3	#NUM!	#NUM!
5.64	0.24218	2.42	24.8	1.395	0.236
6.56	3.62719	36.27	569.2	2.755	1.597
7.52	6.51684	65.17	5742.3	3.759	2.601
8.00	9.29404	92.94	13185.1	4.119	2.961

KOHLER Figure 9a - Hematite - Closed Squares = 1.95% CO_2 (average digitized 9(a) & 9(b))
Cs=1 g/l; 1.95% CO2; I=0.1 M NaClO4; 1.2E-7M
Asp(m2/g)= 14.4 % Np(V) adsorbed

X COORD pH	Y COORD	on 1g/L Hematite	Kd	log Kd	log Ka (mL/m2)
4.78	-0.01797	-0.18	-1.8	#NUM!	#NUM!
5.49	-0.03724	-0.37	-3.7	#NUM!	#NUM!
5.71	-0.02519	-0.25	-2.5	#NUM!	#NUM!
6.13	1.09465	10.95	122.9	2.090	0.931
6.54	3.20648	32.06	472.0	2.674	1.516
7.08	6.33135	63.31	1725.8	3.237	2.079
7.59	7.49555	74.96	2892.9	3.476	2.318
7.98	8.78010	87.80	2086.5	3.319	2.161
8.41	4.81066	48.11	927.0	2.967	1.809
8.85	0.23093	2.31	23.8	1.374	0.215
9.05	-0.03242	-0.32	-3.2	#NUM!	#NUM!

KOHLER Figure 10 - Goethite - Open Circles = No CO_2 (average digitized 10(a) & 10(b))
Cs=1 g/l; No CO2; I=0.1 M NaClO4; 1.2E-7M
Asp(m2/g)= 45 % Np(V) adsorbed

X COORD pH	Y COORD	on 1g/L Goethite	Kd	log Kd	log Ka (mL/m2)
3.83	-0.02828	-0.28	-2.8	#NUM!	#NUM!
4.23	-0.04111	-0.41	-4.1	#NUM!	#NUM!
3.19	0.21743	2.17	22.2	1.347	-0.306
4.42	0.63310	6.33	67.6	1.830	0.177
4.91	0.47958	4.80	50.4	1.702	0.049
5.34	2.04003	20.40	256.3	2.409	0.756
6.04	6.47086	64.71	1833.6	3.263	1.610
6.40	8.62415	86.24	6268.2	3.797	2.144
6.85	9.71042	97.10	33532.2	4.525	2.872
6.22	9.88117	98.81	83153.6	4.920	3.267

KOHLER Figure 10 - Goethite - Closed Squares = 1.95% CO_2 (average digitized 10(a) & 10(b))
Cs=1 g/l; 1.95% CO2; I=0.1 M NaClO4; 1.2E-7M
Asp(m2/g)= 45 % Np(V) adsorbed

X COORD pH	Y COORD	on 1g/L Goethite	Kd	log Kd	log Ka (mL/m2)
3.58	-0.02468	-0.25	-2.5	#NUM!	#NUM!
5.62	2.38715	23.87	313.6	2.496	0.843
6.28	5.89166	58.92	1434.1	3.157	1.503
6.54	7.34789	73.48	2770.6	3.443	1.789
7.42	9.47833	94.78	18169.2	4.259	2.606
7.95	9.36049	93.60	14636.8	4.165	2.512
8.41	8.53276	85.33	5815.5	3.765	2.111
8.76	4.32760	43.28	762.9	2.882	1.229

Neptunium data pts - KOHLER (1999)

TITLE

Project No.

Book No.

("Y_COORD" numbers are for digitizing grid)

NAGASAKI Figure 2 - Open Circles = 0.01 M $NaClO_4$

0.889g/L; No CO_2; 0.01 M $NaClO_4$; 1E-8 M

Asp(m2/g)= 35.5

X_COORD pH	Y_COORD	% Adsorbed	Kd	log Kd	log Ka (mL/m2)
4.00	0.20839	2.08	23.9	1.379	-0.171
4.51	0.73446	7.34	89.2	1.950	0.400
5.06	1.13779	11.38	144.4	2.160	0.609
5.55	3.82077	38.21	695.5	2.842	1.292
6.00	7.48576	74.86	3349.1	3.525	1.975
6.51	9.06398	90.64	10892.6	4.037	2.487
7.00	9.48484	94.85	20710.3	4.316	2.766
7.56	9.80049	98.00	55256.2	4.742	3.192

Poorly Crystalline IFO

NAGASAKI Figure 2 - Open Squares = 0.01 M $NaClO_4$

0.889g/L; No CO_2; 0.01 M $NaClO_4$; 1E-8 M

Asp(m2/g)= 35.5

X_COORD pH	Y_COORD	% Adsorbed	Kd	log Kd	log Ka (mL/m2)
4.49	0.59418	5.94	71.1	1.852	0.301
5.04	1.41836	14.18	185.9	2.269	0.719
5.49	4.22409	42.24	822.6	2.915	1.365
6.04	7.46340	74.63	3309.7	3.520	1.970
6.51	9.31936	93.19	15401.6	4.188	2.637
7.50	9.68648	96.86	34753.5	4.541	2.991

NAGASAKI Figure 2 - Closed Circles = 0.01 M $NaClO_4$

0.889g/L; No CO_2; 0.01 M $NaClO_4$; 1E-8 M

Asp(m2/g)= 35.5

X_COORD pH	Y_COORD	% Adsorbed	Kd	log Kd	log Ka (mL/m2)
4.02	0.22593	2.26	26.0	1.415	-0.135
4.53	0.85722	8.57	105.5	2.023	0.473
4.97	1.31315	13.13	170.0	2.231	0.680
5.48	4.03120	40.31	759.7	2.881	1.330
6.00	7.48576	74.86	3349.1	3.525	1.975
6.55	9.29195	92.92	14761.9	4.169	2.619
7.04	9.43224	94.32	18687.4	4.272	2.721
7.49	9.88817	98.88	99461.7	4.998	3.447
8.04	9.88817	98.88	99461.7	4.998	3.447

NAGASAKI Figure 2 - Cross Squares = 1 M $NaClO_4$

0.889g/L; No CO_2; 1 M $NaClO_4$; 1E-8 M

Asp(m2/g)= 35.5

X_COORD pH	Y_COORD	% Adsorbed	Kd	log Kd	log Ka (mL/m2)
4.00	0.24346	2.43	28.1	1.448	-0.102
5.00	1.22547	12.25	157.1	2.196	0.646
5.98	7.36301	73.63	3140.8	3.497	1.947
6.55	9.29195	92.92	14761.9	4.169	2.619
7.07	9.60759	96.08	27540.6	4.440	2.890
8.04	9.81802	98.18	90687.4	4.783	3.233

Neptunium data pts - NAGASAKI

("Y_COORD" numbers are for digitizing grid)

NAKATA Figure 2 - Open Circles =Anaerobic

Magnetite; Cs=25 g/L; 6E-6M; No CO_2; 0.1 M $NaNO_3$

Asp(m2/g)= 1

X_COORD pH	Y_COORD	Np % sorbed	Kd	log Kd	log Ka (mL/m2)
5.06	6.43361	64.34	72.2	1.858	1.858
5.25	9.34456	93.45	570.3	2.756	2.756
5.23	8.87109	88.71	314.3	2.497	2.497
5.28	8.43269	84.33	215.2	2.333	2.333
5.76	8.25734	82.57	189.5	2.278	2.278
6.02	8.06444	80.64	166.7	2.222	2.222
7.19	9.78295	97.83	1802.9	3.256	3.256
7.70	9.95831	99.58	9554.6	3.980	3.980

NAKATA Figure 2 - Closed Squares =Aerobic

Magnetite; Cs=25 g/L; 6E-6M; No CO_2; 0.1 M $NaNO_3$

Asp(m2/g)= 1

X_COORD pH	Y_COORD	Np % sorbed	Kd	log Kd	log Ka (mL/m2)
4.21	0.10317	1.03	0.4	-0.380	-0.380
5.37	0.47143	4.71	2.0	0.296	0.296
6.05	1.76908	17.69	8.6	0.934	0.934
7.11	2.75108	27.51	15.2	1.181	1.181
7.84	4.18902	41.89	28.8	1.460	1.460

NAKATA Figure 3 - Open Circles =Anaerobic

Hematite; Cs=25 g/L; 6E-6M; No CO_2; 0.1 M $NaNO_3$

Asp(m2/g)= 5.8

X_COORD pH	Y_COORD	Np % sorbed	Kd	log Kd	log Ka (mL/m2)
4.92	2.75108	27.51	15.2	1.181	0.418
5.04	3.62788	36.28	22.8	1.357	0.594
5.51	8.04691	80.47	164.8	2.217	1.454

NAKATA Figure 3 - Closed Squares =Aerobic

Hematite; Cs=25 g/L; 6E-6M; No CO_2; 0.1 M $NaNO_3$

Asp(m2/g)= 5.8

X_COORD pH	Y_COORD	Np % sorbed	Kd	log Kd	log Ka (mL/m2)
4.30	0.68186	6.82	2.9	0.466	-0.297
4.72	2.36530	23.65	12.4	1.093	0.330
5.58	8.38009	83.80	206.9	2.316	1.552
6.74	9.95831	99.58	9554.6	3.980	3.217
7.44	9.99338	99.93	60383.0	4.781	4.017

Neptunium data pts - NAKATA

Project No.

Book No.

8/12/2004

Recorded by:

("Y COORD" numbers are for digitizing grid)

NAKAYAMA Figure 3a - Closed Circles = Natl Goethite
Natural Goethite; Cs=1 g/L; 6E-6M; No CO2; 0.1 M NaNO3
Asp(m2/g)= 15.7

X COORD pH	Y COORD	Np % sorbed	Kd	log Kd	log Ka (mL/m2)
4.15	-0.02979	-0.30	-3.0	#NUM!	#NUM!
4.68	0.25518	2.55	26.2	1.418	0.222
5.56	1.03886	10.39	115.9	2.064	0.868
5.85	1.15285	11.53	130.3	2.115	0.919
6.08	1.50907	15.09	177.7	2.250	1.054
6.33	2.05052	20.51	257.9	2.412	1.216
6.49	2.96244	29.62	420.9	2.624	1.428
6.97	4.07383	40.74	687.4	2.837	1.641
7.06	4.08808	40.88	691.5	2.840	1.644
6.97	4.47280	44.73	809.2	2.908	1.712
7.06	4.41580	44.16	790.8	2.898	1.702
7.19	5.01425	50.14	1005.7	3.002	1.807
8.08	5.88342	58.83	1429.2	3.155	1.959
8.63	6.52461	65.25	1877.4	3.274	2.078
8.67	6.63860	66.39	1975.0	3.296	2.100
9.61	7.08031	70.80	2425.0	3.385	2.189
9.95	7.96373	79.64	3910.9	3.592	2.396
10.16	7.99223	79.92	3980.7	3.600	2.404
10.62	8.14896	81.49	4402.4	3.644	2.448

NAKAYAMA Figure 3a - Open Triangles = Natl Hematite
Natural Hematite; Cs=1 g/L; 6E-6M; No CO2; 0.1 M NaNO3
Asp(m2/g)= 3.2

X COORD pH	Y COORD	Np % sorbed	Kd	log Kd	log Ka (mL/m2)
3.48	0.25518	2.55	26.2	1.418	0.913
4.17	0.38342	3.83	39.9	1.601	1.096
4.45	0.41192	4.12	43.0	1.633	1.128
5.18	1.01036	10.10	112.4	2.051	1.546
5.38	1.19560	11.96	135.8	2.133	1.628
5.95	0.38342	3.83	39.9	1.601	1.096
6.20	0.41192	4.12	43.0	1.633	1.128
6.76	0.58290	5.83	61.9	1.792	1.287
6.96	0.92487	9.25	101.9	2.008	1.503
7.04	0.63990	6.40	68.4	1.835	1.330
7.20	1.29534	12.95	148.8	2.173	1.667
8.38	0.86788	8.68	95.0	1.978	1.473
8.80	1.85104	18.51	227.2	2.356	1.851
8.94	1.25259	12.53	143.2	2.156	1.651
9.17	1.87953	18.80	231.5	2.364	1.859
9.52	1.32383	13.24	152.6	2.184	1.678
9.94	1.95078	19.51	242.4	2.384	1.879
10.36	2.57772	25.78	347.3	2.541	2.036
10.72	2.80570	28.06	390.0	2.591	2.086

NAKAYAMA Figure 3a - Closed Squares = Natl Magnetite
Natural Magnetite; Cs=1 g/L; 6E-6M; No CO2; 0.1 M NaNO3
Asp(m2/g)= 5.8

X COORD pH	Y COORD	Np % sorbed	Kd	log Kd	log Ka (mL/m2)
3.74	0.82513	8.25	89.9	1.954	1.190
4.31	0.78238	7.82	84.9	1.929	1.165
4.88	0.78238	7.82	84.9	1.929	1.165
5.33	0.95337	9.53	105.4	2.023	1.259
5.82	0.51166	5.12	53.9	1.732	0.968
5.98	0.78238	7.82	84.9	1.929	1.165
6.08	1.08161	10.82	121.3	2.084	1.320
6.43	0.58290	5.83	61.9	1.792	1.028
6.89	0.54016	5.40	57.1	1.757	0.993
7.43	0.95337	9.53	105.4	2.023	1.259
8.20	1.83679	18.37	225.0	2.352	1.589
8.43	1.87953	18.80	231.5	2.364	1.601
8.61	1.52332	15.23	179.7	2.255	1.491
9.10	2.54922	25.49	342.1	2.534	1.771
9.14	2.46373	24.64	326.9	2.514	1.751
9.44	2.52073	25.21	337.0	2.528	1.764
9.59	2.49223	24.92	332.0	2.521	1.758
9.94	3.70337	37.03	588.2	2.769	2.006
10.16	3.16192	31.62	462.4	2.665	1.902
10.66	4.82902	48.29	933.9	2.970	

NAKAYAMA Figure 3a - Open Circles = Natl Biotite
Natural Biotite; Cs=1 g/L; 6E-6M; No CO2; 0.1 M NaNO3
Asp(m2/g)= 7.5

X COORD pH	Y COORD	Np % sorbed	Kd	log Kd	log Ka (mL/m2)
4.52	0.24093	2.41	24.7	1.392	0.517
4.76	0.11269	1.13	11.4	1.057	0.182
4.94	0.14119	1.41	14.3	1.156	0.281
5.56	0.41192	4.12	43.0	1.633	0.758
6.03	0.51166	5.12	53.9	1.732	0.857
6.50	0.46891	4.69	49.2	1.692	0.817
6.67	0.51166	5.12	53.9	1.732	0.857
7.17	0.54016	5.40	57.1	1.757	0.882
7.88	0.55446	5.54	58.7	1.769	0.894
8.18	1.45207	14.53	169.6	2.230	1.355
8.44	0.92487	9.25	101.9	2.008	1.133
9.07	1.43782	14.38	167.9	2.225	1.350
7.29	1.18135	11.81	134.0	2.127	1.252
9.07	2.10751	21.08	267.0	2.427	1.551
9.54	2.15025	21.50	273.9	2.438	1.563
9.61	2.64895	26.49	360.4	2.557	1.682
9.89	2.77720	27.77	384.5	2.585	1.710
9.88	2.96245	29.62	420.9	2.624	1.749
10.32	2.89119	28.91	406.7	2.609	1.734
10.14	4.20207	42.02	724.8	2.860	1.985
10.61	4.55829	45.58	837.7	2.923	2.048
10.88	6.92358	69.24	2250.5	3.352	2.477
11.13	7.30825	73.08	2715.1	3.434	2.559

NAKAYAMA Figure 3b - Closed Triangles = Synth Hematite
Synthetic Hematite; Cs=1 g/L; 6E-6M; No CO2; 0.1 M NaNO3
Asp(m2/g)= 5.9

X COORD pH	Y COORD	Np % sorbed	Kd	log Kd	log Ka (mL/m2)
4.34	0.54016	5.40	57.1	1.757	0.986
4.82	0.32642	3.26	33.7	1.528	0.757
5.59	0.82513	8.25	89.9	1.954	1.183
6.46	0.76813	7.68	83.2	1.920	1.149
6.57	1.49482	14.95	175.8	2.245	1.474
6.66	1.16710	11.67	132.1	2.121	1.350
6.96	1.03886	10.39	115.9	2.064	1.293
7.24	1.13860	11.39	128.5	2.109	1.338
8.08	2.86269	28.63	401.1	2.603	1.832
8.71	3.17617	31.76	465.5	2.668	1.897
8.70	3.95984	39.60	655.6	2.817	2.046
8.87	3.81736	38.17	617.4	2.791	2.020
9.24	4.80052	48.01	923.3	2.965	2.194
9.45	6.05440	60.54	1534.5	3.186	2.415
10.19	4.43005	44.30	795.3	2.901	2.130
10.41	6.48187	64.82	1842.4	3.265	2.495
10.58	7.18005	71.80	2546.2	3.406	2.635
10.61	7.25130	72.51	2638.1	3.421	2.650
10.66	5.61269	56.13	1279.3	3.107	2.336
10.91	8.63342	86.33	6317.5	3.801	3.030

NAKAYAMA Figure 3b - Open Squares = Synth Magnetite
Synthetic Magnetite; Cs=1 g/L; 6E-6M; No CO2; 0.1 M NaNO3
Asp(m2/g)= 5.5

X COORD pH	Y COORD	Np % sorbed	Kd	log Kd	log Ka (mL/m2)
3.82	0.19819	1.98	20.2	1.306	0.565
4.75	0.41192	4.12	43.0	1.633	0.893
5.32	0.56865	5.69	60.3	1.780	1.040
6.03	0.83938	8.39	91.6	1.962	1.222
6.70	0.78238	7.82	84.9	1.929	1.188
6.82	1.15285	11.53	130.3	2.115	1.375
7.04	0.82513	8.25	89.9	1.954	1.214
7.04	1.29534	12.95	148.8	2.173	1.432
7.60	1.48057	14.81	173.8	2.240	1.500
7.87	1.93653	19.37	240.2	2.381	1.640
7.94	1.79404	17.94	218.6	2.340	1.599
8.28	1.73705	17.37	210.2	2.323	1.582
8.47	1.55181	15.52	183.7	2.264	1.524
8.71	2.34974	23.50	307.1	2.487	1.747
9.28	2.36399	23.64	309.6	2.491	1.750
9.24	3.04793	30.48	438.4	2.642	1.902
9.69	3.11917	31.19	453.3	2.656	1.916
9.99	3.36140	33.61	506.3	2.704	1.964
10.41	4.48705	44.87	813.9	2.911	2.170

NAKAYAMA Figure 4 - Open Circles = Y-AlOOH
Synthetic Boehmite(gamma AlOOH); Cs=1 g/L; 6E-6M; No CO2; 0.1 M NaNO3
Asp(m2/g)= 175

X COORD pH	Y COORD	Np % sorbed	Kd	log Kd	log Ka (mL/m2)
4.96	2.23575	22.36	288.0	2.459	0.216
5.51	1.02461	10.25	114.2	2.058	-0.186
6.40	3.57513	35.75	556.5	2.745	0.502
7.27	5.58420	55.84	1264.6	3.102	0.859
7.43	6.55311	65.53	1901.2	3.279	1.036
7.68	7.65026	76.50	3255.8	3.513	1.270
8.06	7.16580	71.66	2528.3	3.403	1.160
8.83	9.20337	92.03	11552.9	4.063	1.820
10.15	9.48834	94.88	18544.2	4.268	2.025
10.32	9.68782	96.88	31032.8	4.492	2.249

NAKAYAMA Figure 4 - Open Triangles = Y-FeOOH
Synthetic Lepidocrocite(gamma FeOOH); Cs=1 g/L; 6E-6M; No CO2; 0.1 M NaNO3
Asp(m2/g)= 36

X COORD pH	Y COORD	Np % sorbed	Kd	log Kd	log Ka (mL/m2)
3.70	1.35233	13.52	156.4	2.194	0.638
4.19	1.29534	12.95	148.8	2.173	0.616
5.52	1.39508	13.95	162.1	2.210	0.654
6.40	1.39508	13.95	162.1	2.210	0.654
6.80	1.52332	15.23	179.7	2.255	0.698
7.20	3.04793	30.48	438.4	2.642	1.086
8.71	7.22280	72.23	2600.7	3.415	1.859
9.37	7.84974	78.50	3650.6	3.562	2.006
10.01	8.64715	86.47	7674.2	3.885	2.329
10.66	9.00389	90.04	9039.1	3.956	2.400

NAKAYAMA Figure 4 - Open squares = δ-Al_2O_3
Synthetic alumina(alpha Al2O3); Cs=1 g/L; 6E-6M; No CO2; 0.1 M NaNO3
Asp(m2/g)= 2.5

X COORD pH	Y COORD	Np % sorbed	Kd	log Kd	log Ka (mL/m2)
5.73	0.81088	8.11	88.2	1.946	1.548
7.09	1.15285	11.53	130.3	2.115	1.717
7.29	0.86788	8.68	95.0	1.978	1.580
7.78	0.89637	8.96	98.5	1.993	1.595
8.07	0.98187	9.82	108.9	2.037	1.639
8.87	1.01036	10.10	112.4	2.051	1.653
9.34	1.42358	14.24	166.0	2.220	1.822
9.97	1.43782	14.38	167.9	2.225	1.827
10.55	1.95078	19.51	242.4	2.384	1.987
10.95	2.53497	25.35	339.6	2.531	2.133

Neptunium data pts - NAKAYAMA (1991)

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("Y COORD" numbers are for digitizing grid)

NERO Figure 8a - Small Diamonds = $[Np]_{aq,i}$: 0.001 µM

(Al)Silica(initial): Cs=20 g/L; 1E-9M; Atm CO2; 0.1 M NaClO4

Asp(m2/g): 430

X COORD pH	Y COORD	Np(V) % sorbed	Kd	log Kd	log Ka (mL/m2)
4.33	0.29718	2.97	1.5	0.185	-2.448
4.61	0.30882	3.09	1.6	0.202	-2.431
4.76	0.59984	6.00	3.2	0.504	-2.130
5.29	0.64641	6.46	3.5	0.538	-2.095
5.57	0.55328	5.53	2.9	0.467	-2.167
5.61	0.66969	6.70	3.6	0.555	-2.079
6.02	1.03056	10.31	5.7	0.759	-1.874
6.34	1.10040	11.00	6.2	0.791	-1.842
6.45	1.39142	13.91	8.1	0.907	-1.726
6.77	1.71737	17.17	10.4	1.016	-1.618
6.81	1.90362	19.04	11.8	1.070	-1.563
6.92	2.14808	21.48	13.7	1.136	-1.497
7.01	2.45075	24.51	16.2	1.210	-1.423
7.24	3.12592	31.26	22.7	1.357	-1.277
7.58	3.71960	37.20	29.6	1.471	-1.162
7.78	4.49954	45.00	40.9	1.612	-1.022
7.87	5.24456	52.45	55.1	1.741	-0.892
7.92	6.02450	60.25	75.8	1.879	-0.754
8.31	7.27008	72.70	133.2	2.124	-0.509
8.68	7.81720	78.17	179.1	2.253	-0.380
8.91	8.51565	85.16	286.8	2.458	-0.176

NERO Figure 8a - Large Diamonds = $[Np]_{aq,i}$: 1 µM

(Al)Silica: Cs=20 g/L; 1E-6M; Atm CO2; 0.1 M NaClO4

Asp(m2/g): 430

X COORD pH	Y COORD	Np(V) % sorbed	Kd	log Kd	log Ka (mL/m2)
3.01	0.29718	2.97	1.5	0.185	-2.448
3.98	0.83266	8.33	4.5	0.657	-1.976
4.21	1.35650	13.57	7.8	0.895	-1.739
4.59	1.25173	12.52	7.2	0.855	-1.779
5.50	0.90251	9.03	5.0	0.696	-1.938
6.38	2.52059	25.21	16.9	1.227	-1.407
6.44	2.45075	24.51	16.2	1.210	-1.423
6.66	3.66140	36.61	28.9	1.461	-1.173
6.80	3.53335	35.33	27.3	1.436	-1.197
7.58	4.90698	49.07	48.2	1.683	-0.951
7.88	5.73348	57.33	67.2	1.827	-0.806
8.82	6.71131	67.11	102.0	2.009	-0.625

NERO Figure 9a - Small Diamonds = $[Np]_{aq,i}$: 0.001 µM

(Al)Silica (washed): Cs=20 g/L; 1E-9M; Atm CO2; 0.1 M NaClO4

Asp(m2/g): 430

X COORD pH	Y COORD	Np % sorbed	Kd	log Kd	log Ka (mL/m2)
3.29	0.90260	9.03	5.0	0.696	-1.938
3.45	0.90260	9.03	5.0	0.696	-1.938
3.77	1.01948	10.19	5.7	0.754	-1.879
6.38	1.50000	15.00	8.8	0.946	-1.688
6.88	0.87588	8.76	4.8	0.681	-1.952
7.39	1.70779	17.08	10.3	1.013	-1.621
7.76	2.22273	22.23	14.3	1.155	-1.478
8.01	3.77273	37.73	30.3	1.481	-1.152

NERO Figure 9a - Large Diamonds = $[Np]_{aq,i}$: 0.7 µM

(Al)Silica (washed): Cs=20 g/L; 7E-7M; Atm CO2; 0.1 M NaClO4

Asp(m2/g): 430

X COORD pH	Y COORD	Np % sorbed	Kd	log Kd	log Ka (mL/m2)
7.18	0.87169	8.72	4.8	0.679	-1.955
7.96	0.72078	7.21	3.9	0.589	-2.044
8.51	0.87662	8.77	4.8	0.682	-1.952
8.96	3.98363	39.84	33.1	1.520	-1.114

NERO Figure 9a - Squares = $[Np]_{aq,i}$: 6 µM

(Al)Silica (washed): Cs=20 g/L; 6E-6M; Atm CO2; 0.1 M NaClO4

Asp(m2/g): 430

X COORD pH	Y COORD	Np % sorbed	Kd	log Kd	log Ka (mL/m2)
7.55	-0.02525	-0.25	-0.1	#NUM!	#NUM!
5.23	0.00566	0.06	0.0	-1.548	-4.181
5.99	0.12643	1.26	0.6	-0.194	-2.827
7.26	0.18590	1.86	0.9	-0.024	-2.657
8.12	1.46287	14.63	8.6	0.933	-1.701
8.32	1.52728	15.27	9.0	0.955	-1.679
8.48	2.81542	28.15	19.6	1.292	-1.341
8.67	2.90398	29.04	20.5	1.311	-1.323
9.19	3.45144	34.51	26.4	1.421	-1.213

NERO Figure 10a - Diamonds = $[Np]_{aq,i}$: 0.7 µM

(Al)Silica (washed): Cs=20 g/L; 7E-7M; Atm CO2; 0.001 M NaClO4

Asp(m2/g): 430

X COORD pH	Y COORD	Np % sorbed	Kd	log Kd	log Ka (mL/m2)
6.59	0.95714	9.57	5.3	0.724	-1.910
6.61	2.41429	24.14	15.9	1.202	-1.432
7.06	2.01429	20.14	12.6	1.101	-1.533
6.84	3.10000	31.00	22.5	1.351	-1.282
7.28	3.77143	37.71	30.3	1.481	-1.152
6.71	2.25714	22.57	14.6	1.164	-1.470
8.32	3.92857	39.29	32.4	1.510	-1.124
8.76	4.42857	44.29	39.7	1.599	-1.034
9.01	5.41429	54.14	59.0	1.771	-0.862

NERO Figure 10a - Squares = $[Np]_{aq,i}$: 6 µM

(Al)Silica (washed): Cs=20 g/L; 6E-6M; Atm CO2; 0.001 M NaClO4

Asp(m2/g): 430

X COORD pH	Y COORD	Np % sorbed	Kd	log Kd	log Ka (mL/m2)
4.56	1.07143	10.71	6.0	0.778	-1.855
6.04	1.05714	10.57	5.9	0.772	-1.862
6.48	1.32857	13.29	7.7	0.884	-1.749
6.52	1.95714	19.57	12.2	1.085	-1.548
6.79	1.52857	15.29	9.0	0.955	-1.678
6.85	1.30000	13.00	7.5	0.873	-1.760
6.89	1.71429	17.14	10.3	1.015	-1.619
6.86	2.18571	21.86	14.0	1.146	-1.488
6.96	2.81429	28.14	19.6	1.292	-1.342
7.62	2.45714	24.57	16.3	1.212	-1.422
7.82	3.28571	32.86	24.5	1.389	-1.245
7.14	2.17143	21.71	13.9	1.142	-1.491

NERO Figure 11a - Triangles = S/Al: 3.7

(Al)Silica (initial; S/Al=3.7): Cs=20 g/L; 1E-9M; Atm CO2; 0.1 M NaClO4

Asp(m2/g): 430

X COORD pH	Y COORD	Np % sorbed	Kd	log Kd	log Ka (mL/m2)
3.96	2.15972	21.60	13.8	1.139	-1.494
4.19	2.63700	26.37	17.9	1.253	-1.380
4.10	3.16084	31.61	23.1	1.364	-1.270
4.45	2.71849	27.18	18.7	1.271	-1.362
4.59	3.05607	30.56	22.0	1.343	-1.291
4.95	2.55551	25.56	17.2	1.235	-1.399
5.24	3.68468	36.85	29.2	1.465	-1.168
5.73	4.49954	45.00	40.9	1.612	-1.022
6.80	5.61707	56.17	64.1	1.807	-0.827
6.99	6.12927	61.29	79.2	1.899	-0.735
7.41	6.81608	68.16	107.0	2.030	-0.604
7.91	7.71243	77.12	168.6	2.227	-0.407
8.28	7.71243	77.12	168.6	2.227	-0.407
8.70	8.11986	81.20	215.9	2.334	-0.299

NERO Figure 11a - Circles = S/Al: 5

(Al)Silica (initial; S/Al=5): Cs=20 g/L; 1E-9M; Atm CO2; 0.1 M NaClO4

Asp(m2/g): 430

X COORD pH	Y COORD	Np % sorbed	Kd	log Kd	log Ka (mL/m2)
3.78	1.82214	18.22	11.1	1.047	-1.587
4.38	2.68356	26.84	18.3	1.263	-1.370
5.49	3.73124	37.31	29.8	1.474	-1.160
5.84	4.23180	42.32	36.7	1.564	-1.069
6.00	4.32493	43.25	38.1	1.581	-1.052
6.39	4.67416	46.74	43.9	1.642	-0.991
6.62	4.80221	48.02	46.2	1.665	-0.969
6.78	5.03502	50.35	50.7	1.705	-0.928
6.91	5.26784	52.68	55.7	1.746	-0.888
7.48	5.51230	55.12	61.4	1.788	-0.845
7.94	5.82661	58.27	69.8	1.844	-0.790
8.40	6.22240	62.22	82.4	1.916	-0.718
8.62	6.82772	68.28	107.6	2.032	-0.602
8.90	7.52618	75.26	152.1	2.182	-0.451
9.05	8.88816	88.88	399.7	2.602	-0.032
9.40	9.03949	90.39	470.6	2.673	0.039

NERO Figure 11a - Squares = S/Al: 10

(Al)Silica (initial; S/Al=10): Cs=20 g/L; 1E-9M; Atm CO2; 0.1 M NaClO4

Asp(m2/g): 430

X COORD pH	Y COORD	Np % sorbed	Kd	log Kd	log Ka (mL/m2)
3.64	2.02003	20.20	12.7	1.102	-1.531
4.25	2.88146	28.81	20.2	1.306	-1.327
4.76	2.68356	26.84	18.3	1.263	-1.370
5.38	3.52171	35.22	27.2	1.434	-1.199
5.88	2.89310	28.93	20.4	1.309	-1.325
6.23	3.99899	39.99	33.3	1.523	-1.111
6.62	4.55775	45.58	41.9	1.622	-1.012
7.41	4.97682	49.77	49.5	1.695	-0.939
7.78	5.95466	59.55	73.6	1.867	-0.767
7.92	6.22240	62.22	82.4	1.916	-0.718
8.25	6.02450	60.25	75.8	1.879	-0.754
8.77	6.50178	65.02	92.9	1.968	-0.665
8.92	6.81608	68.16	107.0	2.030	-0.604
9.26	7.63094	76.31	161.1	2.207	-0.426

NERO Figure 12a - Open Triangles = N_2-atm; S/Al: 3.7

(Al)Silica (washed; S/Al=3.7): Cs=20 g/L; 1E-9M; No CO2; 0.1 M NaClO4

Asp(m2/g): 430

X COORD pH	Y COORD	Np % sorbed	Kd	log Kd	log Ka (mL/m2)
4.12	0.52857	5.29	2.8	0.446	-2.188
5.75	1.15714	11.57	6.5	0.816	-1.818
6.59	0.10000	1.00	0.5	-0.297	-2.930
7.09	3.41429	34.14	25.9	1.414	-1.220
7.88	6.38571	63.86	88.3	1.946	-0.687
8.36	6.97143	69.71	115.1	2.061	-0.572

NERO Figure 12a - Closed Triangles = Atm CO_2; S/Al: 3.7

(Al)Silica (washed; S/Al=3.7): Cs=20 g/L; 1E-9M; Atm CO2; 0.1 M NaClO4

Asp(m2/g): 430

X COORD pH	Y COORD	Np % sorbed	Kd	log Kd	log Ka (mL/m2)
4.04	0.40000	4.00	2.1	0.319	-2.315
6.68	2.22857	22.29	14.3	1.156	-1.477
7.16	2.54286	25.43	17.0	1.232	-1.402
7.41	3.14286	31.43	22.9	1.360	-1.273
7.61	5.07143	50.71	51.4	1.711	-0.922
8.04	6.97143	69.71	115.1	2.061	-0.572
8.85	7.17143	71.71	126.8	2.103	-0.530

NERO Figure 12a - Open Circles = N_2-atm; S/Al: 5

(Al)Silica (washed; S/Al=5): Cs=20 g/L; 1E-9M; No CO2; 0.1 M NaClO4

Asp(m2/g): 430

X COORD pH	Y COORD	Np % sorbed	Kd	log Kd	log Ka (mL/m2)
3.68	0.24286	2.43	1.2	0.095	-2.538
4.52	1.11429	11.14	6.3	0.797	-1.836
5.32	1.04286	10.43	5.8	0.765	-1.868
6.49	1.87143	18.71	11.5	1.061	-1.572
7.34	3.88571	38.86	31.8	1.502	-1.131
7.49	3.85714	38.57	31.4	1.497	-1.137
7.84	5.10000	51.00	52.0	1.716	-0.917

NERO Figure 12a - Closed Circles = Atm CO_2; S/Al: 5

(Al)Silica (washed; S/Al=5): Cs=20 g/L; 1E-9M; Atm CO2; 0.1 M NaClO4

Asp(m2/g): 430

X COORD pH	Y COORD	Np % sorbed	Kd	log Kd	log Ka (mL/m2)
4.14	0.15714	1.57	0.8	-0.098	-2.731
5.38	0.41429	4.14	2.2	0.335	-2.299
6.82	0.77143	7.71	4.2	0.621	-2.012
7.22	4.64286	46.43	43.3	1.637	-0.997
7.65	6.80000	68.00	106.3	2.026	-0.607
7.88	6.87143	68.71	109.8	2.041	-0.593
8.29	7.74286	77.43	171.5	2.234	-0.399
8.68	7.58571	75.86	157.1	2.196	-0.437
9.21	8.38571	83.86	259.7	2.415	-0.219

NERO Figure 12a - Open Squares = N_2-atm; S/Al: 10

(Al)Silica (washed; S/Al=10): Cs=20 g/L; 1E-9M; No CO2; 0.1 M NaClO4

Asp(m2/g): 430

X COORD pH	Y COORD	Np % sorbed	Kd	log Kd	log Ka (mL/m2)
4.36	0.38571	3.86	2.0	0.302	-2.331
5.09	0.74286	7.43	4.0	0.603	-2.030
5.48	0.98571	9.86	5.5	0.738	-1.896
5.56	0.44286	4.43	2.3	0.365	-2.269
5.89	0.51429	5.14	2.7	0.433	-2.200
6.08	1.77143	17.71	10.8	1.032	-1.601
7.18	4.74286	47.43	45.1	1.654	-0.979
7.34	5.67143	56.71	65.5	1.816	-0.817
7.82	5.85714	58.57	70.7	1.849	-0.784
8.86	3.12857	31.29	22.8	1.357	-1.276

NERO Figure 12b - Open Triangles = S/Al: 3.7

(Al)Silica (washed; S/Al=3.7): Cs=20 g/L; 1E-9M; No CO2; 0.001 M NaClO4

Asp(m2/g): 430

X COORD pH	Y COORD	Np % sorbed	Kd	log Kd	log Ka (mL/m2)
4.38	0.41429	4.14	2.2	0.335	-2.299
5.81	0.32857	3.29	1.7	0.230	-2.403
6.25	1.77143	17.71	10.8	1.032	-1.601
6.59	2.88571	28.86	20.3	1.307	-1.326
7.21	4.24286	42.43	36.8	1.566	-1.067
7.19	4.95714	49.57	49.2	1.692	-0.942
7.46	5.77143	57.71	68.2	1.834	-0.799
7.74	6.41429	64.14	89.4	1.952	-0.682
8.22	7.24286	72.43	131.3	2.118	-0.515
8.34	7.01429	70.14	117.5	2.070	-0.564
8.84	7.50000	75.00	150.0	2.176	-0.457

NERO Figure 12b - Open Circles = S/Al: 5

(Al)Silica (washed; S/Al=5): Cs=20 g/L; 1E-9M; No CO2; 0.001 M NaClO4

Asp(m2/g): 430

X COORD pH	Y COORD	Np % sorbed	Kd	log Kd	log Ka (mL/m2)
4.09	0.54286	5.43	2.9	0.458	-2.176
5.28	0.71429	7.14	3.8	0.585	-2.048
6.39	1.67143	16.71	10.0	1.001	-1.632
6.84	3.18571	31.86	23.4	1.369	-1.265
7.21	3.68571	36.86	29.2	1.465	-1.168
7.86	5.28571	52.86	56.1	1.749	-0.885
8.58	6.55714	65.57	95.2	1.979	-0.655

NERO Figure 12b - Open Squares = S/Al: 10

(Al)Silica (washed; S/Al=10): Cs=20 g/L; 1E-9M; No CO2; 0.001 M NaClO4

Asp(m2/g): 430

X COORD pH	Y COORD	Np % sorbed	Kd	log Kd	log Ka (mL/m2)
4.35	0.28571	2.86	1.5	0.167	-2.466
5.26	0.82857	8.29	4.5	0.655	-1.979
5.49	0.84286	8.43	4.6	0.663	-1.971
5.62	2.55714	25.57	17.2	1.235	-1.398
5.82	2.08571	20.86	13.2	1.120	-1.514
5.84	2.75714	27.57	19.0	1.280	-1.354
6.25	1.88571	18.86	11.6	1.065	-1.568
6.34	2.61429	26.14	17.7	1.248	-1.386
6.44	2.47143	24.71	16.4	1.215	-1.418
6.62	2.85714	28.57	20.0	1.301	-1.332
6.49	3.52857	35.29	27.3	1.436	-1.198
6.61	3.50000	35.00	26.9	1.430	-1.203
6.89	3.40000	34.00	25.8	1.411	-1.223
7.29	3.58571	35.86	28.0	1.446	-1.187
7.48	4.21429	42.14	36.4	1.561	-1.072
7.55	5.45714	54.57	60.1	1.779	-0.855
7.71	5.77143	57.71	68.2	1.834	-0.799
8.02	6.21429	62.14	82.1	1.914	-0.719
8.45	6.10000	61.00	78.1	1.893	-0.740

NERO Figure 12c - (Black Triangles = I: 0.1M; S/Al: 3.7

(Al)Silica (washed; S/Al=3.7): Cs=10 g/L; 2E-6M; Atm CO2; 0.1 M NaClO4

Asp(m2/g): 430

X COORD pH	Y COORD	Np % sorbed	Kd	log Kd	log Ka (mL/m2)
3.62	0.20000	2.00	2.0	0.310	-2.324
3.76	0.20000	2.00	2.0	0.310	-2.324
3.95	0.01429	0.14	0.1	-0.844	-3.478
4.49	0.17143	1.71	1.7	0.242	-2.392
4.55	0.34286	3.43	3.6	0.550	-2.083
5.76	0.87143	8.71	9.5	0.980	-1.654
5.99	0.75714	7.57	8.2	0.913	-1.720
6.22	0.52857	5.29	5.6	0.747	-1.887
6.79	0.95714	9.57	10.6	1.025	-1.609
7.49	1.64286	16.43	19.7	1.294	-1.340
7.66	1.62857	16.29	22.4	1.350	-1.264
5.49	0.32857	3.29	3.4	0.531	-2.102

NERO Figure 12c - Grey Triangles = I: 0.001M; S/Al: 3.7

(Al)Silica (washed; S/Al=3.7): Cs=10 g/L; 2E-6M; Atm CO2; 0.001 M NaClO4

Asp(m2/g): 430

X COORD pH	Y COORD	Np % sorbed	Kd	log Kd	log Ka (mL/m2)
4.24	0.25714	2.57	2.6	0.421	-2.212
4.99	0.31429	3.14	3.2	0.511	-2.122
6.39	0.75714	7.57	8.2	0.913	-1.720
7.56	2.30000	23.00	29.9	1.475	-1.158
7.69	2.42857	24.29	32.1	1.506	-1.127
7.98	2.54286	25.43	34.1	1.533	-1.101
8.45	2.95714	29.57	42.0	1.623	-1.010

NERO Figure 12c - Black Squares = I: 0.1M; S/Al: 10

(Al)Silica (washed; S/Al=10): Cs=10 g/L; 2E-6M; atm CO2; 0.1 M NaClO4

Asp(m2/g): 430

X COORD pH	Y COORD	Np % sorbed	Kd	log Kd	log Ka (mL/m2)
3.34	0.31429	3.14	3.2	0.511	-2.122
4.41	0.27143	2.71	2.8	0.446	-2.188
5.72	0.61429	6.14	6.5	0.816	-1.818
6.54	0.70000	7.00	7.5	0.877	-1.757
7.34	1.35714	13.57	15.7	1.196	-1.438
7.45	1.45714	14.57	17.1	1.232	-1.402
7.85	1.77143	17.71	21.5	1.333	-1.300
8.46	2.57143	25.71	34.6	1.539	-1.094
9.48	3.04286	30.43	43.7	1.641	-0.993

NERO Figure 12c - Grey Squares = I: 0.001M; S/Al: 10

(Al)Silica (washed; S/Al=10): Cs=10 g/L; 2E-6M; Atm CO2; 0.001 M NaClO4

Asp(m2/g): 430

X COORD pH	Y COORD	Np % sorbed	Kd	log Kd	log Ka (mL/m2)
3.54	0.17143	1.71	1.7	0.242	-2.392
4.25	0.65714	6.57	7.0	0.847	-1.786
5.08	0.54286	5.43	5.7	0.759	-1.875
5.46	0.42857	4.29	4.5	0.651	-1.982
6.91	1.44286	14.43	16.9	1.227	-1.407
7.19	1.10000	11.00	12.4	1.092	-1.541
7.54	1.90000	19.00	23.5	1.370	-1.263
7.79	2.18571	21.86	28.0	1.447	-1.187
8.54	2.88571	28.86	40.6	1.608	-1.025
9.48	3.67143	36.71	54.0	1.764	-0.870

Neptunium data pts - DEL NERO (2004)

8/12/2004 [initials]

Recorded by:

Date

Verified by:

Date

NERO Figure 14a - Open Triangles = S/Fe 2.3
(Al)Silica (initial S/Al=2.3) Ca=20 g/L 1E-6M Atm CO2 0.1 M NaClO4
Aso(m2/g) 430

X COORD pH	Y COORD	Ns % sorbed	Kd	log Kd	log Ka (mL/m2)
3.16	0.72211	7.22	3.9	0.590	-2.043
3.89	1.00668	10.07	5.6	0.748	-1.886
4.91	1.73233	17.32	10.5	1.020	-1.613
5.27	2.27302	22.73	14.7	1.168	-1.466
5.79	3.95199	39.52	32.7	1.514	-1.119
5.86	3.49667	34.97	26.9	1.429	-1.204
5.96	3.92353	39.24	32.3	1.509	-1.124
6.59	4.67684	46.77	47.6	1.678	-0.956
6.87	5.47444	54.74	60.5	1.782	-0.852
7.03	5.91553	59.16	72.4	1.860	-0.774
7.46	6.74078	67.41	103.4	2.015	-0.619
7.94	7.46644	74.66	147.4	2.168	-0.465
8.17	8.43398	84.34	269.3	2.430	-0.203
8.71	8.47667	84.77	278.2	2.444	-0.189
8.95	8.57627	85.76	301.2	2.479	-0.155

NERO Figure 14a - Open Circles = S/Fe 5
(Al)Silica (initial S/Al=5) Ca=20 g/L 1E-6M Atm CO2 0.1 M NaClO4
Aso(m2/g) 430

X COORD pH	Y COORD	Ns % sorbed	Kd	log Kd	log Ka (mL/m2)
3.55	0.53714	5.37	2.8	0.453	-2.180
4.80	0.90708	9.07	5.0	0.698	-1.936
5.59	1.80348	18.03	11.0	1.041	-1.592
5.96	2.82793	28.28	19.7	1.295	-1.339
6.26	3.31170	33.12	24.8	1.394	-1.240
7.17	4.58227	45.82	42.5	1.628	-1.005
7.43	5.23256	52.33	54.9	1.739	-0.894
7.56	5.67364	56.74	65.6	1.817	-0.817
7.87	6.15741	61.57	80.1	1.904	-0.730
8.62	7.89330	78.93	187.3	2.273	-0.361
8.87	8.16364	81.64	222.3	2.347	-0.287

NERO Figure 14a - Open Squares = S/Fe 10
(Al)Silica (initial S/Al=10) Ca=20 g/L 1E-6M Atm CO2 0.1 M NaClO4
Aso(m2/g) 430

X COORD pH	Y COORD	Ns % sorbed	Kd	log Kd	log Ka (mL/m2)
4.24	0.75056	7.51	4.1	0.608	-2.025
4.84	0.87852	8.79	4.8	0.683	-1.951
5.11	0.89285	8.93	4.9	0.690	-1.943
5.40	1.14896	11.49	6.5	0.812	-1.821
5.91	1.43354	14.34	8.4	0.923	-1.711
6.05	1.80348	18.03	11.0	1.041	-1.592
7.17	4.19387	41.94	36.1	1.558	-1.076
7.50	4.36462	43.65	38.7	1.588	-1.045
7.57	4.97644	49.76	49.5	1.695	-0.939
7.66	5.36061	53.61	57.8	1.762	-0.872
8.04	5.90130	59.01	72.0	1.857	-0.778
8.47	6.54158	65.42	94.6	1.976	-0.658
8.62	7.03958	70.40	118.9	2.075	-0.558

NERO Figure 14b - Open Triangles = S/Fe 2.3
(Al)Silica (initial S/Al=2.3) Ca=20 g/L 1E-9M Atm CO2 0.1 M NaClO4
Aso(m2/g) 430

X COORD pH	Y COORD	Ns % sorbed	Kd	log Kd	log Ka (mL/m2)
3.67	0.30316	3.03	1.6	0.194	-2.439
3.69	0.15094	1.51	0.8	-0.118	-2.749
3.81	0.23052	2.31	1.2	0.072	-2.562
3.91	0.17758	1.78	0.9	-0.044	-2.677
4.15	0.43709	4.37	2.3	0.359	-2.275
5.80	1.25885	12.59	7.2	0.857	-1.776
6.50	2.21035	22.10	14.2	1.152	-1.482
6.81	4.41612	44.16	39.5	1.597	-1.036
6.76	4.86304	48.63	47.3	1.675	-0.958
7.17	6.10288	61.03	78.3	1.894	-0.740
7.23	6.57864	65.79	96.1	1.983	-0.651
7.47	7.44364	74.44	145.6	2.163	-0.470
7.69	7.73198	77.32	170.5	2.232	-0.402
7.77	8.45282	84.53	273.2	2.436	-0.197
8.15	8.15007	81.50	220.3	2.343	-0.290
8.34	8.67090	86.71	392.8	2.594	-0.039
8.52	9.70708	97.07	1657.0	3.219	0.586
8.41	8.92857	89.29	418.7	2.620	0.014
8.47	8.88532	88.85	398.8	2.600	-0.033
8.51	8.81324	88.13	371.3	2.570	-0.064
8.53	8.66537	86.65	324.6	2.511	-0.122
8.66	8.38432	83.84	259.5	2.414	-0.219
8.48	8.30865	83.09	245.6	2.390	-0.243
8.36	9.06964	90.70	487.4	2.688	0.054
5.56	0.67976	6.80	3.6	0.562	-2.072

NERO Figure 14b - Open Circles = S/Fe 5
(Al)Silica (initial S/Al=5) Ca=20 g/L 1E-9M Atm CO2 0.1 M NaClO4
Aso(m2/g) 430

X COORD pH	Y COORD	Ns % sorbed	Kd	log Kd	log Ka (mL/m2)
4.57	0.38779	3.88	2.0	0.305	-2.329
4.72	0.37394	3.74	1.9	0.288	-2.345
5.22	0.74544	7.45	4.0	0.605	-2.028
5.40	0.89040	8.90	3.7	0.569	-2.064
5.66	0.86927	8.69	4.8	0.678	-1.956
6.15	0.89579	8.97	4.9	0.692	-1.941
6.19	1.24077	12.41	7.1	0.850	-1.783
6.35	1.55723	15.57	9.2	0.965	-1.669
6.87	1.63879	16.40	9.8	0.992	-1.642
7.03	2.17840	21.78	13.9	1.143	-1.490
7.41	3.64864	36.49	29.7	1.458	-1.175
7.52	4.06141	40.61	34.2	1.534	-1.100
7.89	5.36854	53.69	58.0	1.763	-0.870
8.26	7.26731	72.67	133.0	2.124	-0.510

NERO Figure 14b - Open Squares = S/Fe 10
(Al)Silica (initial S/Al=10) Ca=20 g/L 1E-9M Atm CO2 0.1 M NaClO4
Aso(m2/g) 430

X COORD pH	Y COORD	Ns % sorbed	Kd	log Kd	log Ka (mL/m2)
3.24	0.78672	7.87	4.3	0.630	-2.003
4.52	0.78672	7.87	4.3	0.630	-2.003
4.76	1.00686	10.07	5.6	0.748	-1.885
5.51	1.21206	12.12	6.9	0.839	-1.795
5.55	1.08942	10.89	6.1	0.786	-1.847
5.57	1.17078	11.71	6.6	0.822	-1.812
5.58	1.24616	12.46	7.1	0.852	-1.781
6.03	1.37836	13.78	8.0	0.903	-1.731
6.04	1.21325	12.13	6.9	0.839	-1.794
7.93	6.52432	65.24	93.9	1.972	-0.661
7.93	6.38672	63.87	88.4	1.946	-0.687
8.22	7.62505	76.25	160.5	2.206	-0.428

NERO Figure 15a - Open Triangles = S/Fe 2.3
(Al)Silica (initial S/Al=2.3) Ca=20 g/L 1E-6M Atm CO2 0.01 M NaClO4
Aso(m2/g) 430

X COORD pH	Y COORD	Ns % sorbed	Kd	log Kd	log Ka (mL/m2)
3.65	0.14875	1.49	0.8	-0.122	-2.756
4.73	0.71101	7.11	3.8	0.583	-2.051
5.25	1.86435	18.64	11.5	1.059	-1.574
6.32	4.05570	40.56	34.1	1.533	-1.101
7.15	5.74246	57.42	87.4	1.629	-0.805
7.89	7.50131	75.01	150.1	2.176	-0.457
8.23	7.89056	78.91	187.0	2.272	-0.362
8.68	8.39515	83.95	261.8	2.418	-0.216
8.74	8.58257	85.83	302.8	2.481	-0.152
6.85	4.70446	47.04	44.4	1.648	-0.986

NERO Figure 15a - Open Circles = S/Fe 5
(Al)Silica (initial S/Al=5) Ca=20 g/L 1E-6M Atm CO2 0.01 M NaClO4
Aso(m2/g) 430

X COORD pH	Y COORD	Ns % sorbed	Kd	log Kd	log Ka (mL/m2)
4.01	0.49476	4.95	2.6	0.415	-2.218
4.66	0.95609	9.56	5.3	0.723	-1.910
5.44	2.03735	20.37	12.8	1.107	-1.526
5.75	2.74077	27.44	18.8	1.277	-1.357
6.00	3.85387	38.54	31.4	1.496	-1.137
6.43	4.11337	41.13	34.9	1.543	-1.090
6.89	4.94954	49.50	49.0	1.690	-0.943
7.20	6.56422	65.64	95.5	1.980	-0.653
7.59	8.92464	89.25	112.6	2.051	-0.582
7.80	7.09784	70.98	122.3	2.087	-0.546
7.78	7.15531	71.55	125.8	2.100	-0.534
8.16	7.28506	72.85	134.2	2.128	-0.506
8.68	7.57339	75.73	156.0	2.193	-0.440
8.81	8.03473	80.35	204.4	2.311	-0.323

NERO Figure 15a - Open Squares = S/Fe 10
(Al)Silica (initial S/Al=10) Ca=20 g/L 1E-6M Atm CO2 0.01 M NaClO4
Aso(m2/g) 430

X COORD pH	Y COORD	Ns % sorbed	Kd	log Kd	log Ka (mL/m2)
3.55	0.86959	8.70	4.8	0.678	-1.956
4.11	1.07143	10.71	6.0	0.778	-1.855
4.31	1.11468	11.15	6.3	0.797	-1.836
4.53	1.30210	13.02	7.5	0.874	-1.759
4.57	1.21560	12.16	6.9	0.840	-1.793
5.19	1.33093	13.31	7.7	0.885	-1.748
5.75	2.13827	21.38	13.6	1.134	-1.500
6.01	2.78702	27.87	19.3	1.286	-1.347
6.43	3.30603	33.06	24.7	1.393	-1.241
6.71	3.98362	39.84	33.1	1.520	-1.114
9.92	4.53145	45.31	41.4	1.617	-1.016
7.18	5.18021	51.80	53.7	1.730	-0.903
7.30	5.48655	54.69	60.3	1.781	-0.853
7.70	6.43447	64.34	90.2	1.955	-0.678
7.92	6.95347	69.53	114.1	2.057	-0.576
8.25	7.24181	72.42	131.3	2.118	-0.515
8.47	7.37156	73.72	140.2	2.147	-0.487
8.70	7.45806	74.58	146.7	2.166	-0.467
8.91	7.94823	79.48	193.7	2.287	-0.346

NERO Figure 15b - Open Triangles = S/Fe 2.3
(Al)Silica (initial S/Al=2.3) Ca=20 g/L 1E-8M Atm CO2 0.01 M NaClO4
Aso(m2/g) 430

X COORD pH	Y COORD	Ns % sorbed	Kd	log Kd	log Ka (mL/m2)
3.77	0.40826	4.08	2.1	0.328	-2.305
4.20	0.40826	4.08	2.1	0.328	-2.305
4.28	0.39384	3.94	2.0	0.312	-2.322
4.85	0.36501	3.65	1.9	0.277	-2.358
5.78	1.83552	18.36	11.2	1.051	-1.583
6.06	3.21953	32.20	23.7	1.375	-1.258
6.09	3.08978	30.90	22.4	1.349	-1.284
6.39	3.46461	34.65	26.5	1.423	-1.210
6.62	4.79096	47.91	46.0	1.663	-0.971
6.91	5.34204	53.42	58.3	1.765	-0.868
7.18	6.72280	67.23	102.6	2.011	-0.622
7.70	8.26540	82.65	238.3	2.377	-0.256
7.82	8.65465	86.55	321.7	2.507	-0.126
7.93	8.64295	86.43	318.4	2.503	-0.130
8.09	8.84658	88.47	383.5	2.584	-0.050
8.75	8.72674	87.27	342.7	2.535	-0.099
8.77	8.04104	80.41	205.2	2.312	-0.321
8.87	8.66907	86.69	325.7	2.513	-0.121
8.90	8.40957	84.10	264.4	2.422	-0.211
8.94	8.79882	87.99	366.3	2.564	-0.070
8.96	8.36632	83.66	256.1	2.408	-0.225

NERO Figure 15b - Open Circles = S/Fe 5
(Al)Silica (initial S/Al=5) Ca=20 g/L 1E-8M Atm CO2 0.01 M NaClO4
Aso(m2/g) 430

X COORD pH	Y COORD	Ns % sorbed	Kd	log Kd	log Ka (mL/m2)
4.93	0.81193	8.12	4.4	0.645	-1.998
5.06	1.04289	10.43	5.8	0.765	-1.869
5.42	0.99934	9.99	5.6	0.744	-1.889
5.80	1.07143	10.71	6.0	0.778	-1.855
6.04	1.54715	15.47	9.2	0.962	-1.672
6.88	2.99003	29.90	21.0	1.323	-1.311
7.02	4.30079	43.01	37.7	1.577	-1.057
7.14	3.57995	35.80	27.9	1.445	-1.188
7.87	6.65072	66.51	99.3	1.997	-0.637
8.16	7.90466	79.05	188.7	2.276	-0.358
8.19	7.80406	78.04	177.7	2.250	-0.384
8.55	8.10682	81.07	214.1	2.331	-0.303
8.62	8.10682	81.07	214.1	2.331	-0.303

NERO Figure 15b - Open Squares = S/Fe 10
(Al)Silica (initial S/Al=10) Ca=20 g/L 1E-8M Atm CO2 0.01 M NaClO4
Aso(m2/g) 430

X COORD pH	Y COORD	Ns % sorbed	Kd	log Kd	log Ka (mL/m2)
4.23	0.82934	8.29	4.5	0.654	-1.990
7.04	3.85387	38.54	31.4	1.496	-1.137
7.24	4.54587	45.46	41.7	1.620	-1.014
7.76	5.95872	59.59	73.7	1.868	-0.766
7.93	6.85256	68.53	108.9	2.037	-0.597
8.02	8.49907	84.99	282.5	2.451	-0.183
8.90	8.65465	86.55	321.7	2.507	-0.126

NERO Figure 16a - Open Squares = N_2-atm, S/Fe 10
(Al)Silica (washed S/Al=10) Ca=20 g/L 1E-9M No CO2 0.1 M NaClO4
Aso(m2/g) 430

X COORD pH	Y COORD	Ns % sorbed	Kd	log Kd	log Ka (mL/m2)
4.36	0.67942	6.79	3.6	0.562	-2.072
5.74	1.16319	11.63	6.6	0.818	-1.815
6.76	3.01290	30.13	21.6	1.334	-1.309
7.64	5.65941	56.59	85.2	1.814	-0.819
8.11	6.81193	68.12	106.8	2.029	-0.605

NERO Figure 16a - Closed Squares = Atm CO_2, S/Fe 10
(Al)Silica (washed S/Al=10) Ca=20 g/L 1E-9M Atm CO2 0.1 M NaClO4
Aso(m2/g) 430

X COORD pH	Y COORD	Ns % sorbed	Kd	log Kd	log Ka (mL/m2)
4.90	1.02091	10.21	5.7	0.755	-1.879
5.45	1.79325	7.93	4.3	0.634	-1.999
5.55	0.42331	4.23	2.2	0.344	-2.289
5.88	0.52291	5.23	2.8	0.441	-2.193
6.22	0.09605	0.96	0.5	-0.314	-2.948
6.65	1.66939	16.69	11.4	1.056	-1.575
7.59	3.93776	39.38	32.5	1.512	-1.122
8.48	7.79370	77.94	176.6	2.247	-0.386
8.75	7.97867	79.79	197.4	2.295	-0.338
8.88	8.67915	86.79	312.0	2.494	-0.139

NERO Figure 16a - Open Triangles = N_2-atm, S/Fe 2.3
(Al)Silica (washed S/Al=2.3) Ca=20 g/L 1E-9M No CO2 0.1 M NaClO4
Aso(m2/g) 430

X COORD pH	Y COORD	Ns % sorbed	Kd	log Kd	log Ka (mL/m2)
3.64	0.36639	3.66	1.9	0.279	-2.354
5.59	0.86439	8.64	4.7	0.675	-1.959
6.50	2.21611	22.16	14.2	1.153	-1.480
7.22	6.57004	65.70	95.8	1.981	-0.652
7.68	7.77847	77.79	175.2	2.243	-0.390
8.13	8.14941	81.49	220.2	2.343	-0.291
8.48	8.30592	83.06	245.1	2.389	-0.244
8.85	8.37707	83.77	258.1	2.412	-0.222

NERO Figure 16a - Closed Triangles = Atm CO_2, S/Fe 2.3
(Al)Silica (washed S/Al=2.3) Ca=20 g/L 1E-9M Atm CO2 0.1 M NaClO4
Aso(m2/g) 430

X COORD pH	Y COORD	Ns % sorbed	Kd	log Kd	log Ka (mL/m2)
4.20	0.36639	3.66	1.9	0.279	-2.354
5.47	0.43754	4.38	2.3	0.358	-2.274
6.88	3.08405	30.84	22.3	1.348	-1.285
7.12	6.61273	66.13	97.6	1.990	-0.644
7.02	7.27847	77.79	175.2	2.243	-0.390
7.16	8.09249	80.92	212.1	2.327	-0.307

Neptunium data pts - DEL NERO (2004)

8/12/2004

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Book No.

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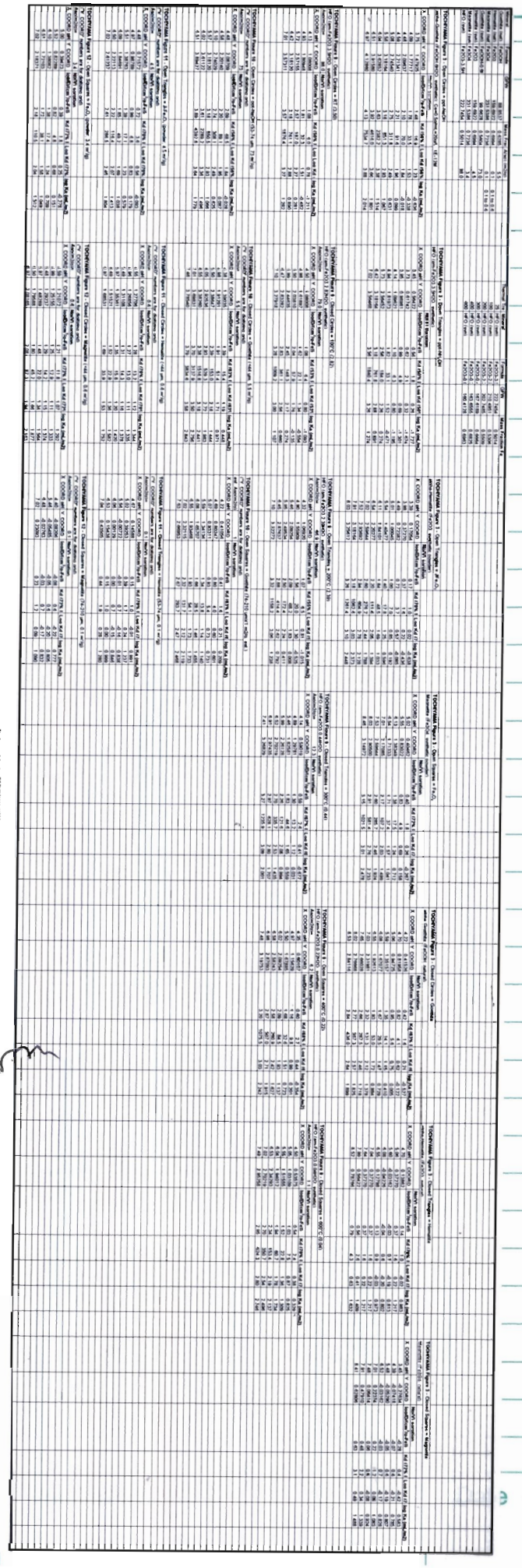

("Y_COORD" numbers are for digitizing grid)

WILK Figure 1, [Np] = 10^{-4}M - Open Squares = Manganite

Manganite (MnOOH); Cs=2.5 mg/mL; 1E-4M; Atm CO2; 0.1 M NaClO4

X_COORD pH	Y_COORD	Np % sorbed	Kd	log Kd
4.11	1.75163	17.52	84.9	1.929
4.95	2.33843	23.38	122.1	2.087
5.66	3.07192	30.72	177.4	2.249
6.60	5.46102	54.61	481.3	2.682
7.73	6.86514	68.65	876.0	2.942
7.84	6.48792	64.88	738.9	2.869
9.66	5.02093	50.21	403.4	2.606
10.17	4.72753	47.28	358.7	2.555

WILK Figure 1, [Np] = 10^{-4}M - Open Circles = Hausmanite

Hausmannite (Mn3O4); Cs=3.35 mg/mL; 1E-4M; Atm CO2; 0.1 M NaClO4

X_COORD pH	Y_COORD	Np % sorbed	Kd	log Kd
4.05	1.81450	18.15	67.2	1.827
5.03	2.48513	24.85	100.2	2.001
6.04	3.17671	31.77	141.1	2.149
7.02	3.26054	32.61	146.6	2.166
8.03	2.17077	21.71	84.0	1.924
9.08	8.56266	85.63	1805.2	3.257
10.06	6.57174	65.72	580.9	2.764

WILK Figure 1, [Np] = 10^{-5}M - Open Squares = Manganite

Manganite (MnOOH); Cs=2.5 mg/mL; 1E-5M; Atm CO2; 0.1 M NaClO4

X_COORD pH	Y_COORD	Np % sorbed	Kd	log Kd
4.05	-0.59555	-5.96	-22.5	#NUM!
4.88	2.14982	21.50	109.5	2.040
5.60	4.64370	46.44	346.8	2.540
6.56	6.04782	60.48	612.1	2.787
7.65	5.02093	50.21	403.4	2.606
8.99	7.89204	78.92	1497.6	3.175
10.08	5.56581	55.66	502.1	2.701

WILK Figure 1, [Np] = 10^{-5}M - Open Circles = Hausmanite

Hausmannite (Mn3O4); Cs=3.35 mg/mL; 1E-5M; Atm CO2; 0.1 M NaClO4

X_COORD pH	Y_COORD	Np % sorbed	Kd	log Kd
5.87	3.07192	30.72	134.4	2.128
6.27	2.12886	21.29	82.0	1.914
6.33	3.21862	32.19	143.8	2.158
6.46	2.10790	21.08	80.9	1.908
7.44	5.08380	50.84	313.4	2.496
7.96	7.22141	72.21	787.6	2.896
8.80	7.82917	78.29	1092.9	3.039
10.42	6.63462	66.35	597.4	2.776

WILK Figure 1, [Np] = 10^{-6}M - Open Squares = Manganite

Manganite (MnOOH); Cs=2.5 mg/mL; 1E-6M; Atm CO2; 0.1 M NaClO4

X_COORD pH	Y_COORD	Np % sorbed	Kd	log Kd
4.42	-0.80512	-8.05	-29.8	#NUM!
5.43	3.76351	37.64	241.4	2.383
5.87	2.75757	27.58	152.3	2.183
6.02	1.77259	17.73	86.2	1.935
6.04	2.65278	26.53	144.4	2.160
7.99	5.67059	56.71	523.9	2.719
8.93	7.82917	78.29	1442.6	3.159
10.35	6.02686	60.27	606.8	2.783

WILK Figure 1, [Np] = 10^{-6}M - Open Circles = Hausmanite

Hausmannite (Mn3O4); Cs=3.35 mg/mL; 1E-6M; Atm CO2; 0.1 M NaClO4

X_COORD pH	Y_COORD	Np % sorbed	Kd	log Kd
5.85	2.29651	22.97	90.3	1.956
6.37	2.88331	28.83	122.8	2.089
6.67	4.22456	42.25	221.7	2.346
6.73	3.80542	38.05	186.2	2.270
6.85	1.60493	16.05	57.9	1.763
8.22	5.92208	59.22	440.1	2.644
8.84	7.47290	74.73	896.1	2.952
10.27	8.16448	81.64	1347.9	3.130

Neptunium data pts - WILK (2005)

("Y_COORD" numbers are for digitizing grid)

ZUYI Figure 1 - Circles = C_b = 0.1 mol l^{-1}

Al2O3; Cs=1 g/100 mL; Np(tot)=1E-5M; CO2: 0.1 M NaNO3

X_COORD pH	Y_COORD	Adsorption % NpO_2^+ onto Al_2O_3	Kd	log Kd
3.54	0.21244	2.12	2.2	0.337
4.45	1.79404	17.94	21.9	1.340
5.94	4.23057	42.31	73.3	1.865
6.84	8.04922	80.49	412.6	2.616
7.41	9.43135	94.31	1658.6	3.220
7.64	9.54534	95.45	2099.4	3.322
8.00	9.63083	96.31	2606.8	3.416

ZUYI Figure 1 - Squares = C_b = 0.01 mol l^{-1}

Al2O3; Cs=1 g/100 mL; Np(tot)=1E-5M; CO2: 0.01 M NaNO3

X_COORD pH	Y_COORD	Adsorption % NpO_2^+ onto Al_2O_3	Kd	log Kd
2.85	0.18394	1.84	1.9	0.273
4.38	0.71114	7.11	7.7	0.884
5.83	2.70596	27.06	37.1	1.569
6.80	6.05440	60.54	153.4	2.186
7.24	8.13472	81.35	436.1	2.640
7.40	8.84715	88.47	767.4	2.885
7.50	9.06088	90.61	964.8	2.984
7.57	9.64508	96.45	2717.5	3.434

ZUYI Figure 1 - Triangles = C_b = 0.001 mol l^{-1}

Al2O3; Cs=1 g/100 mL; Np(tot)=1E-5M; CO2: 0.001 M NaNO3

X_COORD pH	Y_COORD	Adsorption % NpO_2^+ onto Al_2O_3	Kd	log Kd
4.12	0.06995	0.70	0.7	-0.152
6.37	1.13860	11.39	12.8	1.109
6.87	6.43912	64.39	180.8	2.257
7.01	7.92098	79.21	381.0	2.581
7.07	8.06347	80.63	416.4	2.619
7.26	9.01813	90.18	918.5	2.963
7.34	9.34585	93.46	1428.7	3.155
7.54	9.55959	95.60	2170.6	3.337
10.35	9.94430	99.44	17853.3	4.252

ZUYI Figure 2 - Squares = C_b = 0.1 mol l^{-1}

SiO2; Cs=1 g/100 mL; Np(tot)=1.1E-5M; CO2: 0.1 M NaNO3

X_COORD pH	Y_COORD	Adsorption % NpO_2^+ onto SiO_2	Kd	log Kd
7.42	0.55855	5.59	5.9	0.772
7.81	1.22539	12.25	14.0	1.145
8.41	1.49896	14.99	17.6	1.246
8.83	2.04611	20.46	25.7	1.410
9.42	2.21710	22.17	28.5	1.455
10.03	1.59016	15.90	18.9	1.277
10.72	0.85492	8.55	9.3	0.971

ZUYI Figure 2 - Circles = C_b = 0.01 mol l^{-1}

SiO2; Cs=1 g/100 mL; Np(tot)=1.1E-5M; CO2: 0.01 M NaNO3

X_COORD pH	Y_COORD	Adsorption % NpO_2^+ onto SiO_2	Kd	log Kd
7.80	-1.15699	-11.57	-10.4	#NUM!
8.41	-0.39896	-3.99	-3.8	#NUM!
8.82	0.21658	2.17	2.2	0.345
10.02	0.21658	2.17	2.2	0.345
9.42	-0.18806	-1.88	-1.8	#NUM!
10.71	-0.52435	-5.24	-5.0	#NUM!

ZUYI Figure 2 - Triangles = C_b = 0.001 mol l^{-1}

SiO2; Cs=1 g/100 mL; Np(tot)=1.1E-5M; CO2: 0.001 M NaNO3

X_COORD pH	Y_COORD	Adsorption % NpO_2^+ onto SiO_2	Kd	log Kd
7.41	-0.80933	-8.09	-7.5	#NUM!
7.80	-0.89482	-8.95	-8.2	#NUM!
8.41	-0.14249	-1.42	-1.4	#NUM!
8.82	-0.38756	-3.88	-3.7	#NUM!
9.42	-0.43866	-4.39	-4.2	#NUM!
10.03	-0.28497	-2.85	-2.8	#NUM!
10.71	-0.37617	-3.76	-3.6	#NUM!

ZUYI Figure 4 - Circles = C_b = 0.1 mol l^{-1}

Fe2O3; Cs=1 g/100 mL; U(tot)=3.2E-5M; CO2: 0.1 M NaNO3

X_COORD pH	Y_COORD	Adsorption % UO_2^{2+} onto Fe_2O_3	Kd	log Kd
4.05	0.34005	3.40	3.5	0.547
5.38	2.02400	20.24	25.4	1.404
5.55	4.13829	41.38	70.6	1.849
5.79	7.24424	72.44	262.9	2.420
6.27	8.81593	88.16	744.5	2.872
8.05	8.55398	85.54	591.6	2.772
10.02	8.44172	84.42	541.7	2.734
10.32	8.75979	87.60	706.3	2.849
10.71	9.07787	90.78	984.4	2.993
10.92	9.20685	92.09	1164.0	3.066

ZUYI Figure 4 - Triangle = C_b = 0.01 mol l^{-1}

Fe2O3; Cs=1 g/100 mL; U(tot)=3.2E-5M; CO2: 0.01 M NaNO3

X_COORD pH	Y_COORD	Adsorption % UO_2^{2+} onto Fe_2O_3	Kd	log Kd
3.26	0.28392	2.84	2.9	0.466
5.47	2.00529	20.05	25.1	1.399
5.88	5.01769	50.18	100.7	2.003
6.52	8.74108	87.41	694.3	2.842
6.63	8.70366	87.04	671.4	2.827
7.27	9.33982	93.40	1414.7	3.151
9.46	9.67661	96.77	2992.2	3.476
9.59	9.60177	96.02	2411.1	3.382
10.37	9.50822	95.08	1933.4	3.286

ZUYI Figure 4 - Down Triangles = C_b = 0.001 mol l^{-1}

Fe2O3; Cs=1 g/100 mL; U(tot)=3.2E-5M; CO2: 0.001 M NaNO3

X_COORD pH	Y_COORD	Adsorption % UO_2^{2+} onto Fe_2O_3	Kd	log Kd
4.40	0.43361	4.34	4.5	0.656
5.41	1.66850	16.69	20.0	1.302
5.73	2.92211	29.22	41.3	1.616
6.03	4.04474	40.45	67.9	1.832
7.19	7.45006	74.50	292.2	2.466
7.36	8.40429	84.04	526.7	2.722
7.57	8.53527	85.35	582.7	2.765
8.78	8.75979	87.60	706.3	2.849
8.86	9.11529	91.15	1030.3	3.013
9.32	9.32111	93.21	1373.0	3.138

ZUYI Figure 5 - Closed Squares = C_b = 0.01 mol l^{-1} Yb

SiO2; Cs=1 g/100 mL; Yb(tot)=3.2E-5M; CO2: 0.01 M NaNO3

X_COORD pH	Y_COORD	Adsorption % UO_2^{2+}, Yb^{3+} onto SiO	Kd	log Kd
2.89	3.87634	38.76	63.3	1.801
3.04	4.43766	44.38	79.8	1.902
3.11	5.87837	58.78	142.6	2.154
3.30	5.67256	56.73	131.1	2.118
3.41	5.44803	54.48	119.7	2.078
4.07	6.85132	68.51	217.6	2.338
4.35	6.98229	69.82	231.4	2.364
6.59	9.15272	91.53	1080.2	3.034
7.49	9.47079	94.71	1789.6	3.253
11.12	9.90114	99.01	10015.3	4.001

ZUYI Figure 5 - Open Squares = C_b = 0.1 mol l^{-1} Yb

SiO2; Cs=1 g/100 mL; Yb(tot)=3.2E-5M; CO2: 0.1 M NaNO3

X_COORD pH	Y_COORD	Adsorption % UO_2^{2+}, Yb^{3+} onto SiO	Kd	log Kd
3.30	6.34614	63.46	173.7	2.240
4.50	7.59974	76.00	316.6	2.501
4.67	7.93653	79.37	384.6	2.585
6.26	9.11529	91.15	1030.3	3.013
7.12	9.28369	92.84	1296.0	3.113
7.62	9.93656	99.39	16176.0	4.209
8.69	9.77016	97.70	4250.9	3.628
9.12	9.86372	98.64	7237.8	3.860
9.23	9.84501	98.45	6352.0	3.803
9.99	9.95727	99.57	23302.6	4.367

ZUYI Figure 5 - Closed Triangles = C_b = 0.001 mol l^{-1} U

SiO2; Cs=1 g/100 mL; U(tot)=3.2E-5M; CO2: 0.001 M NaNO3

X_COORD pH	Y_COORD	Adsorption % UO_2^{2+}, Yb^{3+} onto SiO	Kd	log Kd
2.79	0.32134	3.21	3.3	0.521
3.34	2.02400	20.24	25.4	1.404
3.36	2.94082	29.41	41.7	1.620
3.99	5.69127	56.91	132.1	2.121
5.36	6.96358	69.64	229.3	2.360
7.70	6.90745	69.07	223.4	2.349
9.96	6.10290	61.03	156.6	2.195
11.40	5.33577	53.36	114.4	2.058
11.25	4.21313	42.13	72.8	1.862
10.97	4.02603	40.26	67.4	1.829

ZUYI Figure 5 - Open Triangles = C_b = 0.01 mol l^{-1} U

SiO2; Cs=1 g/100 mL; U(tot)=3.2E-5M; CO2: 0.01 M NaNO3

X_COORD pH	Y_COORD	Adsorption % UO_2^{2+}, Yb^{3+} onto SiO	Kd	log Kd
2.66	0.65813	6.58	7.0	0.848
2.76	1.23816	12.38	14.1	1.150
3.32	3.59569	35.96	56.1	1.749
4.27	6.96358	69.64	229.3	2.360
6.20	7.33779	73.38	275.6	2.440
6.89	7.69329	76.93	333.5	2.523
7.00	8.49785	84.98	565.7	2.753
8.45	8.19848	81.98	455.1	2.658
10.80	5.72869	57.29	134.1	2.127

ZUYI Figure 5 - "x" = C_b = 0.1 mol l^{-1} U

SiO2; Cs=1 g/100 mL; U(tot)=3.2E-5M; CO2: 0.1 M NaNO3

X_COORD pH	Y_COORD	Adsorption % UO_2^{2+}, Yb^{3+} onto SiO	Kd	log Kd
3.11	2.21111	22.11	28.4	1.453
4.91	6.45840	64.58	182.4	2.261
5.38	8.47914	84.79	557.5	2.746
6.80	8.75979	87.60	706.3	2.849
7.66	8.77851	87.79	718.7	2.857
10.24	8.64753	86.48	639.4	2.806
10.82	8.98432	89.84	884.6	2.947
11.14	9.04045	90.40	942.2	2.974
11.46	8.98432	89.84	884.6	2.947

Neptunium data pts - ZUYI

("Y_COORD" numbers are for digitizing grid)

ZAVARIN Figure 10 - Open Circles = at 24 Hours

Calcite; Cs=50 mg/40 mL; 1E-7M; .03% CO2; 0.1 M $NaClO_4$

X_COORD pH	Y_COORD	Np % sorbed	Kd	log Kd
7.11	1.54162	15.42	145.8	2.164
7.22	1.31824	13.18	121.5	2.084
7.61	1.54162	15.42	145.8	2.164
7.88	1.98839	19.88	198.6	2.298
8.16	2.11870	21.19	215.1	2.333
8.50	2.21177	22.12	227.2	2.356
8.82	1.39270	13.93	129.4	2.112
9.17	1.53231	15.32	144.8	2.161
9.33	1.02040	10.20	90.9	1.959
9.62	0.00586	0.06	0.5	-0.329

Neptunium data pts - ZAVARIN (2005)

Neptunium data pts - ZUYI

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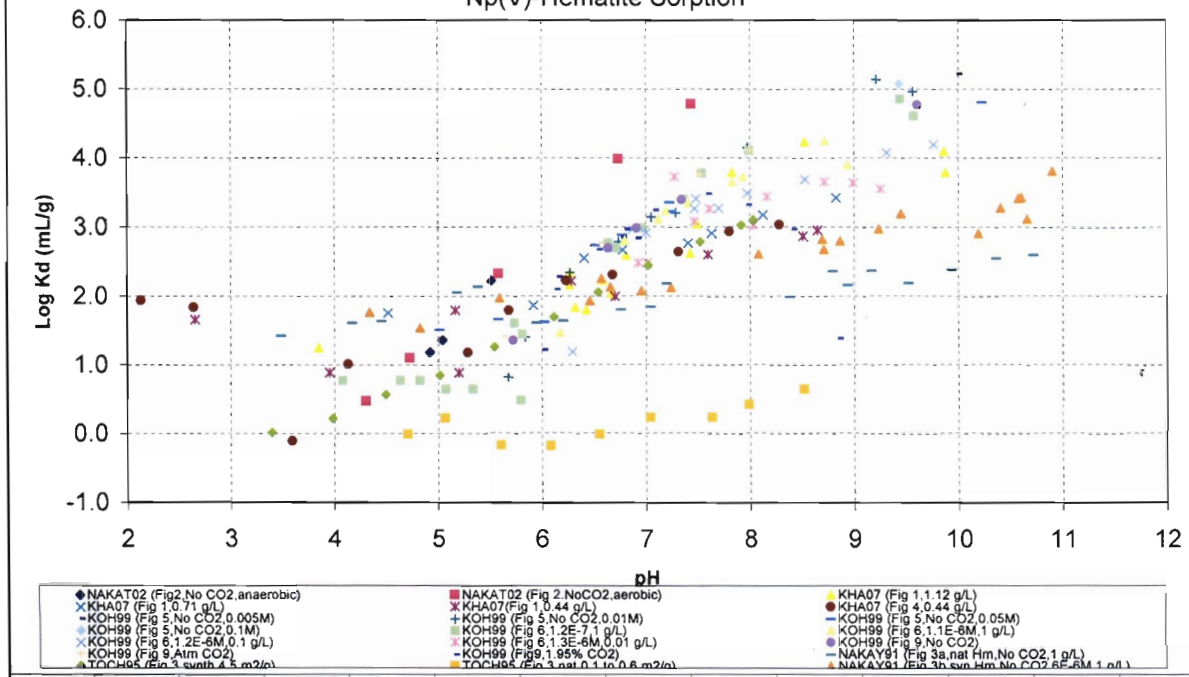

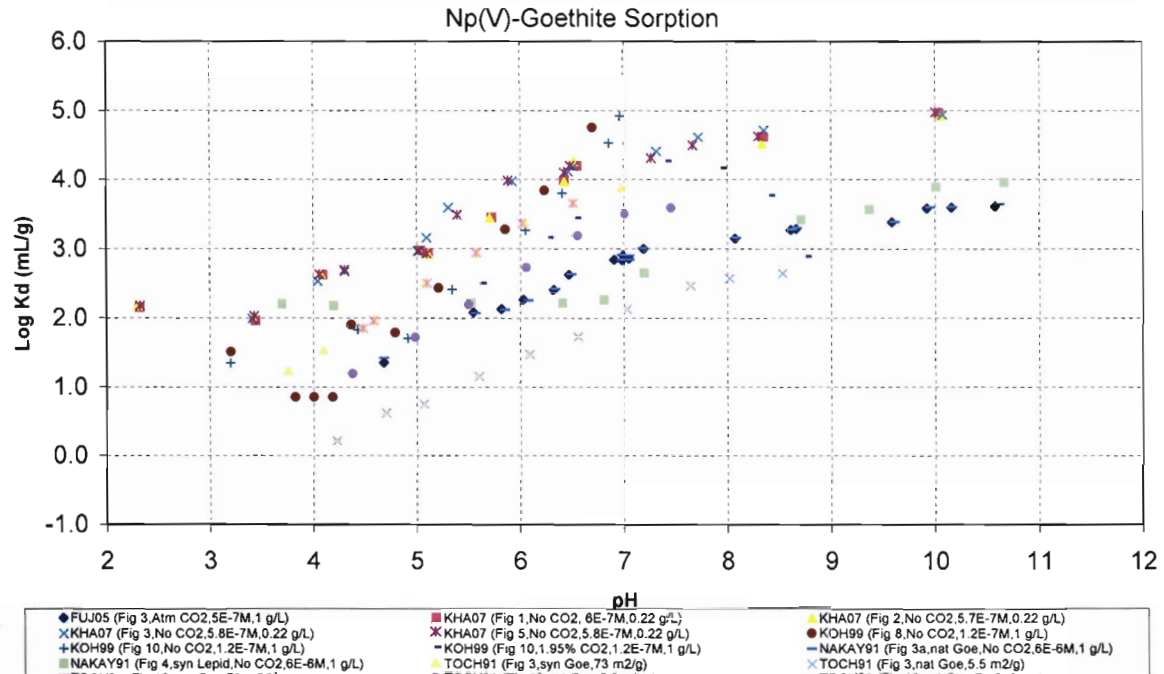

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GIR91			X					
HEB08								X
JER07		X						
KHA07	X	X						
KOH99	X	X			X			
NAG98			X					
NAKAT02	X			X				
NAKAY91	X	X		X		X	X(bt)	
DELNER04							X	
TOCH95	X	X	X	X				
WILK05								
ZAV05								X
ZUYI04					X	X		

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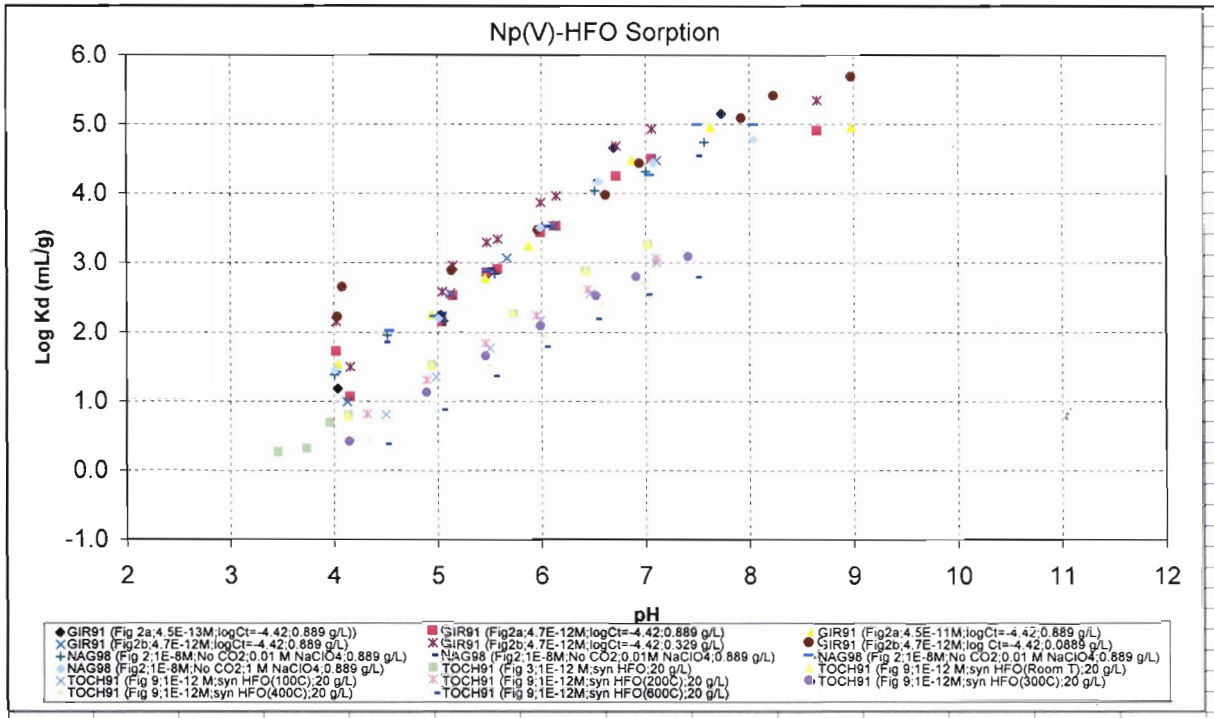

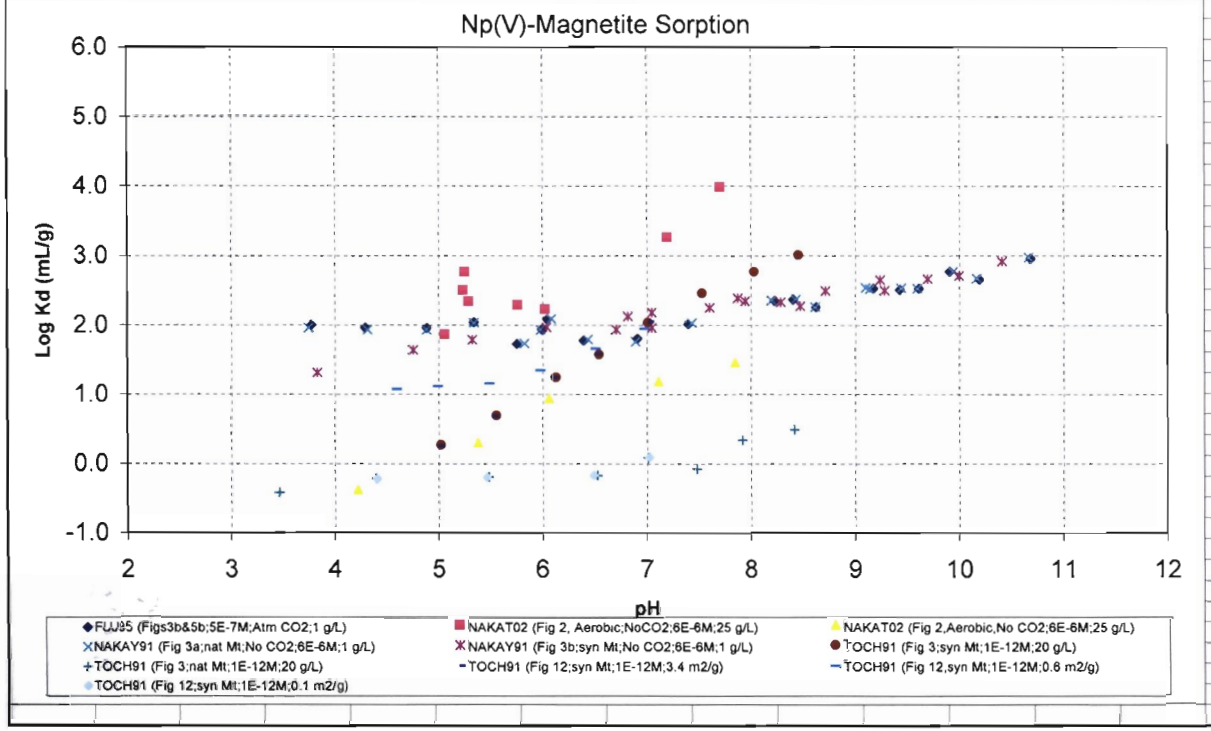

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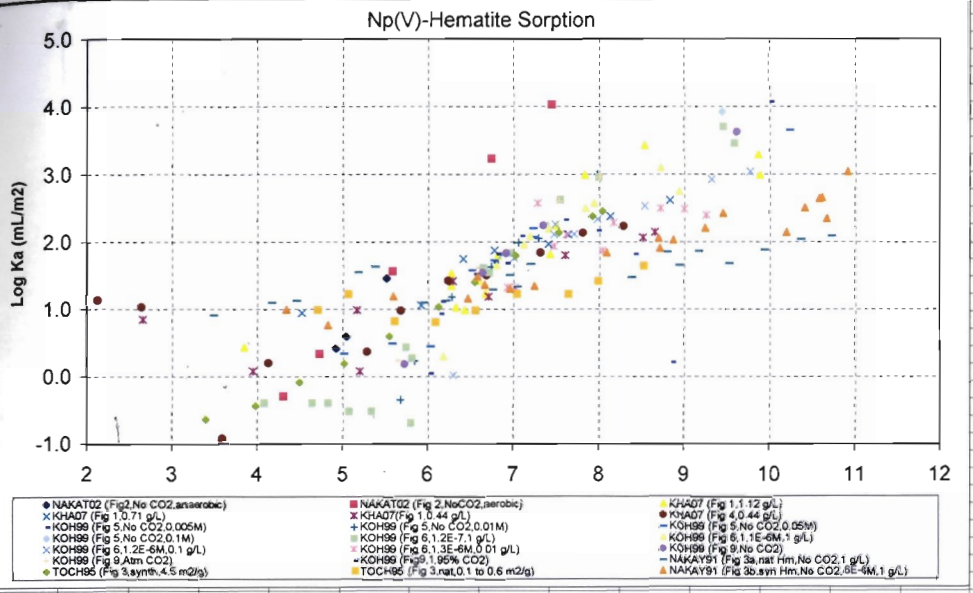

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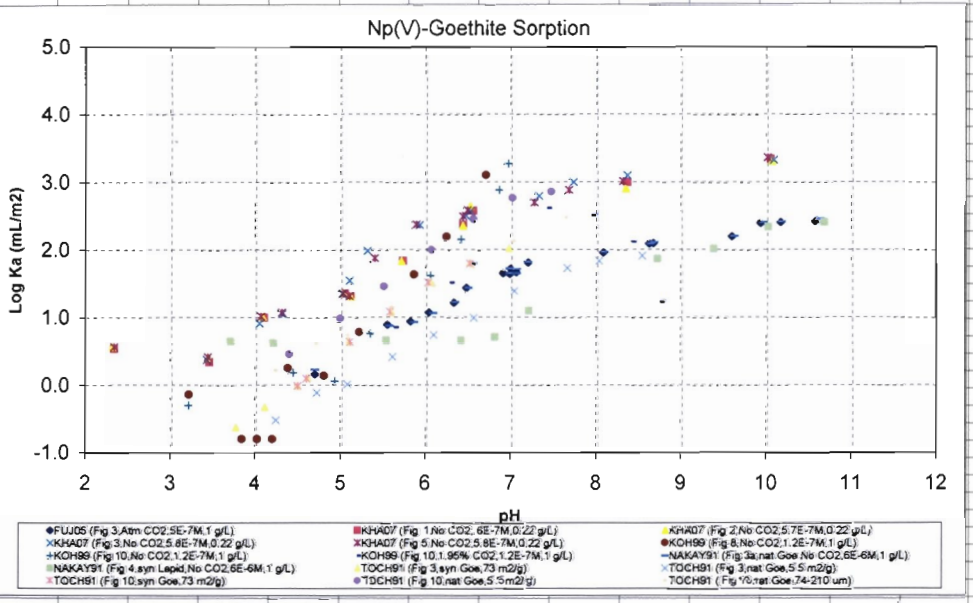
FUJ95		X		X				
GIR91			X					
HEB08								X
JER07		X						
KHA07	X	X						
KOH99	X	X			X			
NAG98			X					
NAKAT02	X			X				
NAKAY91	X	X		X		X	X(bt)	
DELNER04							X	
TOCH95	X	X	X	X				
WILK05								
ZAV05								
ZUYI04					X	X		



Neptunium data pts - Graphs - Log Ka

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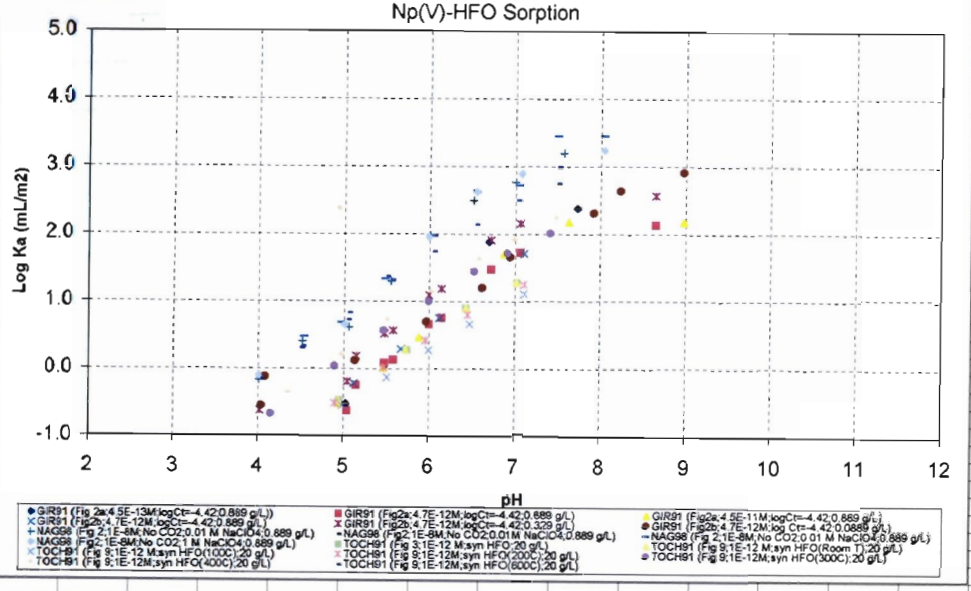

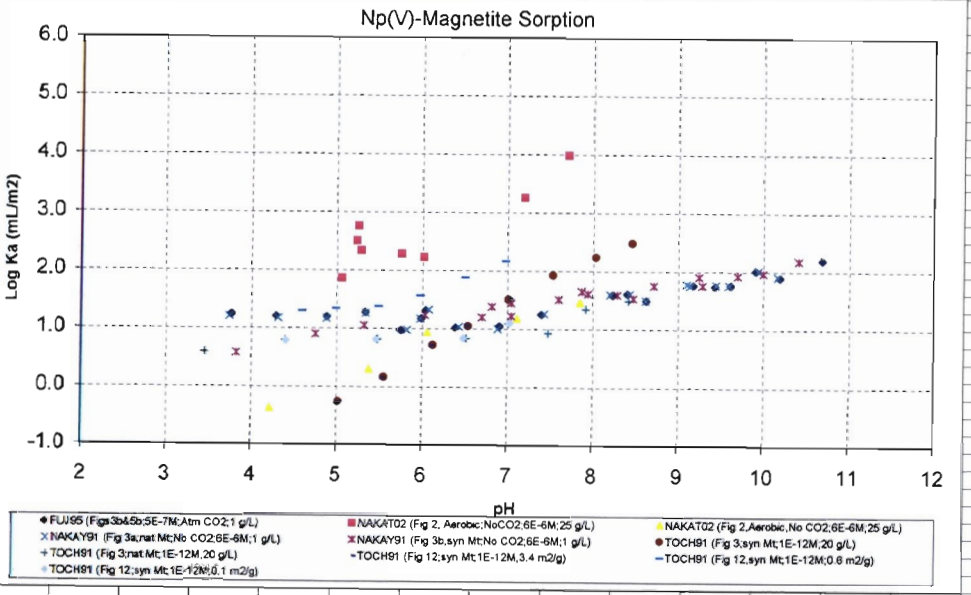

Project No. _____ 21

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Keeney Figure 4a (^{238}Pu 10^{-10}M)
Closed Circles = Aragonite (deionized water)
1E-10 M; Atm CO2; pH=7.8 to 8.2; 5 mL/L

X COORD	Y COORD	% Adsorption		
Log Time (min)			Ka (mL/m	log Ka (mL/m2)
0.71	9.86914	96.89	5844.9	3.77
1.52	9.71037	97.10	6705.4	3.83
2.10	9.77909	97.79	8853.5	3.95
2.58	9.86154	98.62	14244.6	4.15
2.94	9.83408	98.34	11852.5	4.07
3.27	9.86154	98.62	14244.6	4.15
3.53	9.88903	98.89	17822.9	4.25
3.68	9.90277	99.03	20369.8	4.31

Keeney Figure 4a (^{238}Pu 10^{-10}M)
Open Circles = Aragonite (S=35 seawater)
1E-10 M; Atm CO2; pH=7.8 to 8.2; 5 mL/L

X COORD	Y COORD	% Adsorption		
Log Time (min)			Ka (mL/m	log Ka (mL/m2)
0.74	5.61498	56.15	256.1	2.41
1.48	6.88307	68.93	443.7	2.65
2.12	8.29485	82.95	972.9	2.99
2.58	9.17440	91.74	2222.5	3.35
3.08	9.49049	94.90	3725.3	3.57
3.23	9.50423	95.04	3834.1	3.58
3.42	9.51797	95.18	3949.1	3.60
3.63	9.58689	95.87	4639.0	3.67

Keeney Figure 4a (^{238}Pu 10^{-10}M)
Closed Squares = Calcite (deionized water)
1E-10 M; Atm CO2; pH=7.8 to 8.2; 5 mL/L

X COORD	Y COORD	% Adsorption		
Log Time (min)			Ka (mL/m	log Ka (mL/m2)
0.70	7.38782	73.88	565.6	2.75
1.52	7.45653	74.57	586.3	2.77
2.09	7.91006	79.10	757.0	2.88
2.81	8.19865	81.99	910.3	2.96
2.91	8.37731	83.77	1032.5	3.01
3.26	8.48725	84.87	1122.1	3.05
3.52	8.54222	85.42	1171.9	3.07
3.68	8.44802	84.48	1087.0	3.04

Keeney Figure 4a (^{238}Pu 10^{-10}M)
Open Squares = Calcite (S=35 seawater)
1E-10 M; Atm CO2; pH=7.8 to 8.2; 5 mL/L

X COORD	Y COORD	% Adsorption		
Log Time (min)			Ka (mL/m	log Ka (mL/m2)
0.75	3.16873	31.69	92.8	1.97
1.51	4.87286	48.73	190.1	2.28
2.10	6.35709	63.57	349.0	2.54
2.80	7.66267	76.63	655.7	2.82
3.10	8.21239	82.12	918.8	2.96
3.27	8.22613	82.26	927.5	2.97
3.56	8.26736	82.67	954.3	2.98
3.65	8.21239	82.12	918.8	2.96

Keeney Figure 4a (^{238}Pu 10^{-10}M)
Closed Triangles = Goethite (deionized water)
1E-10 M; Atm CO2; pH=7.8 to 8.2; 5 mL/L

X COORD	Y COORD	% Adsorption			
Log Time (min)			Ka (mL/m2	log Ka (mL/m2)	
0.70	8.98200	89.82	1784.8	3.25	
1.47	9.83408	98.34	11852.5	4.07	
2.57	9.97149	99.71	89950.8	4.84	
2.94	9.99897	99.99	1941547.8	6.29	
3.27	9.99897	99.99	1941547.8	6.29	
3.52	9.98523	99.85	135208.8	5.13	
3.68	9.98523	99.85	135208.8	5.13	
2.12	9.87529	98.75	15837.2	4.20	

Keeney Figure 4a (^{238}Pu 10^{-10}M)
Open Triangles = Goethite (S=35 seawater)
1E-10 M; Atm CO2; pH=7.8 to 8.2; 5 mL/L

X COORD	Y COORD	% Adsorption		
Log Time (min)			Ka (mL/m2	log Ka (mL/m2)
0.73	2.23421	22.34	57.5	1.76
1.50	4.99000	49.89	197.5	2.30
2.12	8.30858	83.09	982.4	2.99
2.55	9.50423	95.04	3834.1	3.58
3.08	9.61417	96.14	4943.8	3.70
3.42	9.67284	96.73	4463.2	3.65
3.54	9.71037	97.10	6705.4	3.83
3.84	9.71037	97.10	6705.4	3.83

Keeney Figure 4b (^{238}Pu 10^{-12}M)
Closed Circles = Aragonite (deionized water)
1E-12 M; Atm CO2; pH=7.8 to 8.2; 5 mL/L

X COORD	Y COORD	% Adsorption		
Log Time (min)			Ka (mL/m	log Ka (mL/m2)
0.73	9.88289	98.83	6107.0	3.79
1.50	9.76534	97.65	8323.0	3.92
2.10	9.73788	97.38	7429.5	3.87
2.57	9.84780	98.48	12940.6	4.11
3.08	9.86154	98.62	14244.6	4.15
3.42	9.90277	99.03	20369.8	4.31
3.64	9.90277	99.03	20369.8	4.31
3.82	9.93028	99.30	28477.9	4.45

Keeney Figure 4b (^{238}Pu 10^{-12}M)
Open Circles = Aragonite (S=35 seawater)
1E-12 M; Atm CO2; pH=7.8 to 8.2; 5 mL/L

X COORD	Y COORD	% Adsorption		
Log Time (min)			Ka (mL/m	log Ka (mL/m2)
0.73	4.77197	41.72	143.3	2.16
1.50	7.92783	49.28	194.3	2.29
2.17	5.56000	55.60	250.5	2.40
2.72	5.90358	59.04	288.2	2.46
3.09	6.06849	60.68	308.7	2.49
3.42	6.24715	62.47	332.9	2.52
3.60	6.42589	64.26	358.6	2.56
3.78	6.32951	63.30	344.9	2.54

Keeney Figure 4b (^{238}Pu 10^{-12}M)
Closed Squares = Calcite (deionized water)
1E-12 M; Atm CO2; pH=7.8 to 8.2; 5 mL/L

X COORD	Y COORD	% Adsorption		
Log Time (min)			Ka (mL/m	log Ka (mL/m2)
0.73	7.01678	70.17	470.4	2.67
1.50	7.58022	75.80	626.5	2.80
2.12	7.88016	78.80	865.8	2.82
2.80	7.81385	78.14	714.9	2.85
3.10	8.14388	81.44	877.4	2.94
3.43	8.25362	82.54	945.2	2.98
3.60	8.29485	82.95	972.9	2.99
3.82	8.23958	82.40	936.3	2.97

Keeney Figure 4b (^{238}Pu 10^{-12}M)
Open Squares = Calcite (S=35 seawater)
1E-12 M; Atm CO2; pH=7.8 to 8.2; 5 mL/L

X COORD	Y COORD	% Adsorption		
Log Time (min)			Ka (mL/m	log Ka (mL/m2)
0.73	2.22047	22.20	57.1	1.76
1.57	2.92136	29.21	82.5	1.92
2.18	3.34739	33.47	100.8	2.00
2.81	3.55354	35.54	110.2	2.04
3.05	3.51231	35.12	108.3	2.03
3.42	3.71845	37.18	118.4	2.07
3.60	3.98331	39.83	133.0	2.12
3.78	3.78717	37.87	121.9	2.08

Keeney Figure 4b (^{238}Pu 10^{-12}M)
Open Triangles = Goethite (S=35 seawater)
1E-12 M; Atm CO2; pH=7.8 to 8.2; 5 mL/L

X COORD	Y COORD	% Adsorption		
Log Time (min)			Ka (mL/m2	log Ka (mL/m2)
0.71	2.20873	22.07	56.6	1.75
1.51	4.52926	45.29	165.8	2.22
2.13	7.82378	78.24	753.3	2.88
2.68	8.95451	89.55	1713.0	3.23
3.06	9.55920	95.59	4337.2	3.64
3.39	9.58689	95.87	4639.0	3.67
3.64	9.50423	95.04	3834.1	3.58
3.78	9.58689	95.87	4639.0	3.67

Plutonium_data_pts - KEENEY

DRL

8/12/2009

Recorded by:	Date	Verified by:	Date

Sanchez Figure 1a - Pu (IV) 10^{-11} on Goethite
Open Circles = 1 Hr (10^{-11}M Pu)
goethite 1E-11M Pu(IV) Atm CO2 28.5 m2/L
Average Asp for 74.2

X COORD pH	Y COORD	% Pu (IV) Ads	Kd	log Kd (m	log Ka (mL/m2)
2.47	2.63276	26.33	930.9	2.97	1.10
2.88	3.73219	37.32	1551.1	3.19	1.32
3.20	4.96906	49.69	2572.8	3.41	1.54
3.60	5.34012	53.40	2985.1	3.47	1.60
4.04	7.89630	78.96	9777.4	3.99	2.12
4.84	9.35306	93.53	37659.5	4.58	2.71
6.44	9.73786	97.38	96764.3	4.99	3.12
8.01	9.71037	97.10	87332.7	4.94	3.07
8.55	9.77909	97.79	115310.2	5.06	3.19
9.00	9.77909	97.79	115310.2	5.06	3.19
9.23	9.82032	98.20	142367.4	5.15	3.28
9.50	9.80657	98.07	132062.1	5.12	3.25

Sanchez Figure 1a - Pu (IV) 10^{-11} on Goethite
Open Triangles = 24 Hrs (10^{-11}M Pu)
goethite 1E-11M Pu(IV) Atm CO2 28.5 m2/L

X COORD pH	Y COORD	% Pu (IV) Ads	Kd	log Kd (mL/g)	log Ka (mL/m2)
2.46	2.50907	25.09	872.5	2.94	1.07
2.64	3.42985	34.30	1359.8	3.13	1.26
2.97	4.51554	45.16	2144.7	3.33	1.46
3.21	4.44683	44.47	2085.9	3.32	1.45
4.08	7.96502	79.65	10195.6	4.01	2.14
6.22	9.49049	94.90	48520.0	4.69	2.82
8.18	9.88903	98.89	232130.8	5.37	3.50
8.95	9.88903	98.89	232130.8	5.37	3.50

Sanchez Figure 1a - Pu (IV) 10^{-11} on Goethite
Open Squares = 96 Hrs (10^{-11}M Pu)
goethite 1E-11M Pu(IV) Atm CO2 28.5 m2/L

X COORD pH	Y COORD	% Pu (IV) Ads	Kd	log Kd (mL/g)	log Ka (mL/m2)
2.29	2.06930	20.69	679.7	2.83	0.96
2.43	2.94885	29.49	1089.4	3.04	1.17
3.05	3.92459	39.25	1682.7	3.23	1.36
3.93	7.25039	72.50	6868.7	3.84	1.97
5.91	9.86154	98.62	185526.2	5.27	3.40
6.95	9.87529	98.75	206268.7	5.31	3.44
7.56	9.80657	98.07	132062.1	5.12	3.25

Sanchez Figure 1a - Pu (IV) 10^{-10} on Goethite
Closed Circles = 24 Hrs (10^{-10}M Pu)
goethite 1E-10M Pu(IV) Atm CO2 28.5 m2/L

X COORD pH	Y COORD	% Pu (IV) Ads	Kd	log Kd (m	log Ka (mL/m2)
2.29	0.91489	9.15	262.3	2.42	0.55
2.99	2.55030	25.50	891.7	2.95	1.08
3.08	3.30616	33.06	1286.6	3.11	1.24
3.75	5.20269	52.03	2825.0	3.45	1.58
3.72	5.46380	54.64	3137.5	3.50	1.63
4.15	6.10972	61.10	4091.0	3.61	1.74
4.25	6.30212	63.02	4439.3	3.65	1.78
5.11	9.09194	90.92	26081.2	4.42	2.55
6.02	9.64166	96.42	70087.6	4.85	2.98

Sanchez Figure 1b - Pu (V) 10^{-11} on Goethite
Large Circles = 1 Hr
goethite 1E-11M Pu(V) Atm CO2 28.5 m2/L

X COORD pH	Y COORD	% Pu (V) Adsc	Kd	log Kd (m	log Ka (mL/m2)
3.78	0.04909	0.49	12.9	1.11	-0.76
4.07	0.07657	0.77	20.1	1.30	-0.57
5.39	0.85992	8.60	245.1	2.39	0.52
5.61	1.03858	10.39	301.9	2.48	0.61
5.92	1.53332	15.33	471.7	2.67	0.80
6.31	2.61902	26.19	924.3	2.97	1.10
6.46	3.48482	34.85	1393.3	3.14	1.27
6.76	5.21643	52.16	2840.6	3.45	1.58
7.60	8.83082	88.31	19674.5	4.29	2.42
8.16	9.72412	97.24	91815.3	4.96	3.09
9.15	9.83406	98.34	154371.3	5.19	3.32

Sanchez Figure 1b - Pu (V) 10^{-11} on Goethite
Small Circles = 60 Hrs
goethite 1E-11M Pu(V) Atm CO2 28.5 m2/L

X COORD pH	Y COORD	% Pu (V) Adsc	Kd	log Kd (mL/g)	log Ka (mL/m2)
3.75	0.18652	1.87	49.5	1.69	-0.18
4.01	0.28272	2.83	75.8	1.88	0.01
5.37	1.34092	13.41	403.4	2.61	0.74
5.92	3.48482	34.85	1393.3	3.14	1.27
6.27	4.81789	48.18	2421.8	3.38	1.51
6.99	7.73139	77.31	8877.3	3.95	2.08
7.25	8.83082	88.31	19674.5	4.29	2.42
7.58	9.33931	93.39	36821.5	4.57	2.70

Sanchez Figure 1b - Pu (V) 10^{-11} on Goethite
Triangles = 5 Days
goethite 1E-11M Pu(V) Atm CO2 28.5 m2/L

X COORD pH	Y COORD	% Pu (V) Adsc	Kd	log Kd (mL/g)	log Ka (mL/m2)
3.76	0.29646	2.96	79.6	1.90	0.03
4.01	0.29646	2.96	79.6	1.90	0.03
5.30	1.73947	17.39	548.5	2.74	0.87
5.63	4.74917	47.49	2356.0	3.37	1.50
5.87	5.02403	50.24	2630.0	3.42	1.55
6.24	7.00301	70.03	6086.7	3.78	1.91
6.97	8.65217	86.52	16721.5	4.22	2.35
7.25	9.32557	93.26	36018.3	4.56	2.69
8.15	9.94400	99.44	462549.1	5.67	3.79

Sanchez Figure 1b - Pu (V) 10^{-11} on Goethite
Down Triangles = 20 Days
goethite 1E-11M Pu(V) Atm CO2 28.5 m2/L

X COORD pH	Y COORD	% Pu (V) Adsc	Kd	log Kd (m	log Ka (mL/m2)
3.90	0.29646	2.96	79.6	1.90	0.03
4.01	1.43712	14.37	437.2	2.64	0.77
4.62	3.42985	34.30	1359.8	3.13	1.26
5.62	9.13317	91.33	27445.6	4.44	2.57
5.89	9.21563	92.16	30604.7	4.49	2.62
6.42	9.58669	95.87	60419.6	4.78	2.91
6.76	9.69663	96.97	83259.3	4.92	3.05

Sanchez Figure 1c - Pu (V) 10^{-10} on Goethite
Large Circles = 1 Hr
goethite 1E-10M Pu(V) Atm CO2 28.5 m2/L

X COORD pH	Y COORD	% Pu (V) Adsorbed	Kd	log Kd (m	log Ka (mL/m2)
2.88	0.06283	0.63			
3.94	0.13154	1.32	34.7	1.54	-0.33
4.59	0.61255	6.13	170.0	2.23	0.36
5.23	0.94238	9.42	271.0	2.43	0.56
5.91	3.08628	30.86	1162.8	3.07	1.19
6.61	6.04101	60.41	3974.8	3.60	1.73
7.06	7.95128	79.51	10109.7	4.00	2.13
7.90	9.33931	93.39	36821.5	4.57	2.70
8.63	9.68289	96.83	79538.9	4.90	3.03
9.73	9.71037	97.10	87332.7	4.94	3.07

Sanchez Figure 1c - Pu (V) 10^{-10} on Goethite
Small Circles = 98 Hrs
goethite 1E-10M Pu(V) Atm CO2 28.5 m2/L

X COORD pH	Y COORD	% Pu (V) Adsc	Kd	log Kd (mL/g)	log Ka (mL/m2)
3.93	0.25523	2.55	68.2	1.83	-0.04
4.59	0.91489	9.15	262.3	2.42	0.55
5.28	2.94885	29.49	1089.4	3.04	1.17
5.91	5.49129	54.91	3172.5	3.50	1.63
6.60	7.95128	79.51	10109.7	4.00	2.13
7.08	8.78960	87.90	18915.8	4.28	2.41
7.90	9.64166	96.42	70087.6	4.85	2.98

Sanchez Figure 1c - Pu (V) 10^{-10} on Goethite
Triangles = 15 Days
goethite 1E-10M Pu(V) Atm CO2 28.5 m2/L

X COORD pH	Y COORD	% Pu (V) Adsc	Kd	log Kd (mL/g)	log Ka (mL/m2)
4.60	1.49209	14.92	456.8	2.66	0.79
5.29	4.17197	41.72	1864.7	3.27	1.40
5.91	7.33284	73.33	7161.6	3.86	1.98
6.60	8.54222	85.42	15263.8	4.18	2.31
7.02	9.07820	90.78	25653.6	4.41	2.54

Sanchez Figure 1c - Pu (V) 10^{-10} on Goethite
Closed Circles = 20 Days
goethite 1E-10M Pu(V) Atm CO2 28.5 m2/L

X COORD pH	Y COORD	% Pu (V) Adsc	Kd	log Kd (m	log Ka (mL/m2)
4.62	1.75321	17.53	553.8	2.74	0.87
5.29	6.17844	61.78	4211.4	3.62	1.75
5.91	7.56647	75.66	8099.2	3.91	2.04
6.60	8.70714	87.07	17543.2	4.24	2.37
7.01	9.27060	92.71	33107.5	4.52	2.65

Sanchez Figure 1c - Pu (V) 10^{-10} on Goethite
Down Triangles = 25 Days
goethite 1E-10M Pu(V) Atm CO2 28.5 m2/L

X COORD	Y COORD	% Pu (V)	Kd	log Kd (m	log Ka (mL/m2)
4.62	2.06930	20.69	679.7	2.83	0.96
5.25	6.74190	67.42	5390.2	3.73	1.86
5.91	7.93753	79.38	10025.0	4.00	2.13
5.60	8.85831	88.58	20211.0	4.31	2.43
5.99	9.42177	94.22	42444.0	4.63	2.76

Sanchez Figure 3 - Goethite
Open Circles = Pu (IV) 10^{-11}M
goethite 1E-11M Pu(IV) Atm CO2 28.5 m2/L

X COORD pH	Y COORD	% Adsorbed	Kd	log Kd (m	log Ka (mL/m2)
2.20	2.04181	20.42	668.3	2.82	0.95
2.38	2.50907	25.09	872.5	2.94	1.07
2.39	3.05879	30.59	1147.9	3.06	1.19
2.44	2.72896	27.29	977.7	2.99	1.12
2.68	3.53979	35.40	1427.3	3.15	1.28
2.83	3.78717	37.87	1587.9	3.20	1.33
3.02	4.10325	41.03	1812.6	3.26	1.39
3.02	4.58426	45.84	2204.9	3.34	1.47
3.17	4.96906	49.69	2572.8	3.41	1.54
3.52	5.42258	54.23	3085.8	3.49	1.62
3.94	7.31910	73.19	7111.5	3.85	1.98
4.08	7.99250	79.93	10370.8	4.02	2.15
4.95	9.40803	94.08	41398.4	4.62	2.75
5.96	9.88903	98.89	232130.8	5.37	3.50
6.29	9.55920	95.59	56489.1	4.75	2.88
6.51	9.79283	97.93	123130.6	5.09	3.22
7.02	9.90277	99.03	265302.4	5.42	3.55
7.35	9.82032	98.20	142367.4	5.15	3.28
7.82	9.87529	98.75	206268.7	5.31	3.44
8.19	9.86154	98.62	185526.2	5.27	3.40
9.10	9.88903	98.89	232130.8	5.37	3.50

Sanchez Figure 4a - Pu (IV) 10^{-11} on Goethite
Open Circles = 1 Hr
goethite 1E-11M Pu(IV) Atm CO2 28.5 m2/L

X COORD	Total Alka. meq/L	Y COORD	% Adsorbed	Kd	log Kd (m	log Ka (mL/m2)
1.46028	14.60	99.79360	99.79	1259440.8	6.10	4.23
25.25701	252.57	99.27250	99.27	355451.8	5.55	3.68
52.00662	520.07	89.54537	89.55	22311.0	4.35	2.48
59.12827	591.28	80.68674	80.69	10882.6	4.04	2.17
75.28226	752.82	45.25218	45.25	2153.1	3.33	1.46
75.10858	751.09	33.26697	33.27	1298.5	3.11	1.24
86.05158	860.52	10.68613	10.69	311.7	2.49	0.62
86.05158	860.52	7.38585	7.39	207.7	2.32	0.45
100.81598	1008.16	2.69598	2.70	72.2	1.86	-0.01

Sanchez Figure 4a - Pu (IV) 10^{-11} on Goethite
Open Triangles = 96 Hrs
("Y COORD" numbers are for digitizing grid)

X COORD	Total Alka. m	Y COORD	% Adsorbed	Kd	log Kd (m	log Ka (mL/m2)
51.48553	514.86	94.23524	94.24	42581.1	4.63	2.76
66.07622	660.76	67.65933	67.66	5449.6	3.74	1.87
75.45596	754.56	45.42588	45.43	2168.2	3.34	1.47
81.01432	810.14	25.27683	25.28	881.2	2.95	1.07
85.87788	858.78	11.38092	11.38	334.5	2.52	0.65
92.65214	926.52	4.60667	4.61	125.8	2.10	0.23
100.46858	1004.69	2.69598	2.70	72.2	1.86	-0.01

Sanchez Figure 4a - Pu (IV) 10^{-11} on Goethite
Soap Lake (12m)
("Y COORD" numbers are for digitizing grid)

X COORD	Total Alka. m	Y COORD	% Adsorbed	Kd	log Kd (mL/g)	log Ka (mL/m2)
58.95457	589.55	94.93003	94.93	48773.4	4.69	2.82

Sanchez Figure 4a - Pu (IV) 10^{-11} on Goethite
Soap Lake (24m)
("Y COORD" numbers are for digitizing grid)
("X COORD" numbers are for digitizing grid)

X COORD	Total Alka	Y COORD	% Adsorb	Kd	log Kd (m	log Ka (mL/m2)
104.63735	1046.37	2.00119	2.00	53.2	1.73	-1.57

Sanchez Figure 4b - Pu (V) 10^{-11} on Goethite
Open Circles = 1 Hr
("Y COORD" numbers are for digitizing grid)
("X COORD" numbers are for digitizing grid)

X COORD	Total Alka. meq/L	Y COORD	% Adsorbed	Kd	log Kd (m	log Ka (mL/m2)
1.11288	11.13	99.27250	99.27	355451.8	5.55	3.68
24.90961	249.10	97.01442	97.01	84643.2	4.93	3.06
51.13813	511.38	84.85551	84.86	14595.2	4.16	2.29
58.95457	589.55	84.16071	84.16	13840.7	4.14	2.27
73.71897	737.19	47.16287	47.16	2325.1	3.37	1.50
74.93486	749.35	19.02367	19.02	612.0	2.79	0.92
85.87788	858.78	4.60667	4.61	125.8	2.10	0.23
100.98968	1009.90	1.48009	1.48	39.1	1.59	-0.28

Sanchez Figure 4b - Pu (V) 10^{-11} on Goethite
Open Triangles = 168 Hrs
("Y COORD" numbers are for digitizing grid)
("X COORD" numbers are for digitizing grid)

X COORD	Total Alka. m	Y COORD	% Adsorbed	Kd	log Kd (m	log Ka (mL/m2)
24.90961	249.10	97.88291	97.88	120434.9	5.08	3.21
50.79073	507.91	94.06154	94.06	41259.4	4.62	2.74
66.59732	665.97	65.22754	65.23	4886.3	3.69	1.82
74.93486	749.35	48.37876	48.38	2441.2	3.39	1.52
74.58746	745.87	34.48286	34.48	1371.0	3.14	1.27
80.66692	806.67	19.89216	19.89	646.8	2.81	0.94
85.87788	858.78	10.68613	10.69	311.7	2.49	0.62
93.52063	935.21	4.60667	4.61	125.8	2.10	0.23
100.64228	1006.42	2.34859	2.35	62.6	1.80	-0.07

Sanchez Figure 4b - Pu (V) 10^{-11} on Goethite
Soap Lake (12m)
("Y COORD" numbers are for digitizing grid)
("X COORD" numbers are for digitizing grid)

X COORD	Total Alka. m	Y COORD	% Adsorbed	Kd	log Kd (mL/g)	log Ka (mL/m2)
58.95457	589.55	91.62976	91.63	28515.7	4.46	2.58

Sanchez Figure 4b - Pu (V) 10^{-11} on Goethite
Soap Lake (24m)
("Y COORD" numbers are for digitizing grid)
("X COORD" numbers are for digitizing grid)

X COORD	Total Alka	Y COORD	% Adsorb	Kd	log Kd (m	log Ka (mL/m2)
105.15845	1051.58	2.17489	2.17	57.9	1.76	-1.53

BET (*m2/g) measurements for goethite using methods of Atkinson et al. (1967)

71	Wijnja and Schulthess (SSSAJ 2001)
49	Gaboriaud and Ehrhardt (GCA 2003) after application of Atkinson et al (1967) methodology by van Geen et al (GCA 1994)
95	Gaboriaud and Ehrhardt (GCA 2003) after application of Atkinson et al (1967) methodology by Hiemstra et al (JCIS 1989)
70.2	Appel et al. (Geoderma 2003)
47.5	Dong and Stone (ES&T 1996)
87.91	O'Reilly et al (SSSAJ 2001)
94	Fuss et al (GCA 2000) after application of Atkinson et al (1967) methodology by Hiemstra et al (JCIS 1989)

6/12/2004

Shaughnessy Figure 3a - Manganite

Down Triangle = Pu(VI) = $1*10^{-7}$M Asp=9.5 m2/g

MnOOH;1E-7M Pu(VI);Atm CO2;10 g/L

X_COORD pH	Y_COORD	% Pu Sorbed in 24 Hours	Kd	log Kd (m	log Ka (mL/m2)
3.15	4.16259	41.63	71.3	1.85	0.88
3.99	3.81976	38.20	61.8	1.79	0.81
5.19	5.58066	55.81	126.3	2.10	1.12
6.14	7.51297	75.13	302.1	2.48	1.50
6.95	9.61669	96.17	2508.9	3.40	2.42
8.01	9.94394	99.44	17738.0	4.25	3.27
8.95	9.97510	99.75	40060.6	4.60	3.62
10.43	9.64786	96.48	2739.8	3.44	2.46

Shaughnessy Figure 3b - Hausmannite

Closed Square = Pu(VI) = $8*10^{-5}$M Asp=20.4 m2/g

Mn3O4;8E-5M Pu(VI);Atm CO2;4 g/L

X_COORD pH	Y_COORD	% Pu Sorbed in 24 Hours	Kd	log Kd (m	log Ka (mL/m2)
3.23	8.21421	82.14	1149.9	3.06	1.75
4.04	7.12339	71.23	619.1	2.79	1.48
5.11	8.30771	83.08	1227.3	3.09	1.78
5.88	8.04279	80.43	1027.3	3.01	1.70
6.91	9.64786	96.48	6849.4	3.84	2.53
8.18	9.91277	99.13	28409.9	4.45	3.14
8.85	9.94394	99.44	44345.1	4.65	3.34
9.81	6.28190	62.82	422.4	2.63	1.32

Shaughnessy Figure 4 - Pu(VI) = $8*10^{-5}$M

Closed Circle = 10 mg Mn_3O_4

Mn3O4;8E-5M Pu(VI);Atm CO2;4 g/L

X_COORD pH	Y_COORD	% Pu(VI) Sorbed in 24 Hrs (mg/m^2)
3.17	20.07289	0.20
4.01	17.42981	0.17
5.10	20.34017	0.20
5.88	19.62743	0.20
6.89	23.54752	0.24
8.16	24.17117	0.24
8.91	24.23056	0.24
9.86	15.38067	0.15

Shaughnessy Figure 3a - Manganite

Closed Square = Pu(VI) = $5*10^{-6}$M

MnOOH;5E-6M Pu(VI);Atm CO2;10 g/L

X_COORD pH	Y_COORD	% Pu Sorbed in 24 Hours	Kd	log Kd (m	log Ka (mL/m2)
3.79	1.91862	19.19	23.7	1.38	0.40
5.04	3.07177	30.72	44.3	1.65	0.67
6.36	5.39366	53.94	117.1	2.07	1.09
7.06	6.26631	62.66	167.8	2.22	1.25
7.97	9.61669	96.17	2508.9	3.40	2.42
8.82	9.95952	99.60	24603.6	4.39	3.41
9.98	8.18304	81.83	450.4	2.65	1.68

Shaughnessy Figure 3b - Hausmannite

Closed Circle = Pu(VI) = $1*10^{-4}$M

Mn3O4;8E-5M Pu(VI);Atm CO2;4 g/L

X_COORD pH	Y_COORD	% Pu Sorbed in 24 Hours	Kd	log Kd (m	log Ka (mL/m2)
3.14	6.03257	60.33	380.1	2.58	1.27
4.01	5.93907	59.39	365.6	2.56	1.25
5.07	5.42483	54.25	296.4	2.47	1.16
6.03	5.90790	59.08	360.9	2.56	1.25
6.91	6.43773	64.38	451.8	2.65	1.35
8.06	9.72577	97.26	8866.4	3.95	2.64
8.87	8.27654	82.77	1200.6	3.08	1.77
9.82	6.26631	62.66	419.6	2.62	1.31

Shaughnessy Figure 4 - Pu(VI) = $8*10^{-5}$M

Closed Triangle = 25 mg MnOOH

MnOOH;8E-5M Pu(VI);Atm CO2;10 g/L

X_COORD pH	Y_COORD	% Pu Adsorbed in 24 Hrs (mg/m^2)
3.00	-0.03240	0.00
4.87	1.00702	0.01
4.99	1.60097	0.02
5.82	2.61069	0.03
7.00	6.38229	0.06
8.01	17.07343	0.17
8.22	20.10259	0.20
8.85	20.60745	0.21
9.02	20.10259	0.20
9.71	13.74730	0.14
10.00	9.26296	0.09

Shaughnessy Figure 3a - Manganite

Closed Circle = Pu(VI) = $8*10^{-5}$M

MnOOH;8E-5M Pu(VI);Atm CO2;10 g/L

X_COORD pH	Y_COORD	% Pu Sorbed in 24 Hours	Kd	log Kd (m	log Ka (mL/m2)
3.00	-0.06044	-0.60	-0.6	#NUM!	#NUM!
4.90	0.50055	5.01	5.3	0.72	-0.26
5.01	0.74988	7.50	8.1	0.91	-0.07
5.83	1.23296	12.33	14.1	1.15	0.17
7.02	3.00944	30.09	43.1	1.63	0.66
8.03	8.16746	81.67	445.7	2.65	1.67
8.25	9.61669	96.17	2508.9	3.40	2.42
8.82	9.86602	98.66	7363.8	3.87	2.89
9.00	9.61669	96.17	2508.9	3.40	2.42
9.70	6.59356	65.94	193.6	2.29	1.31
10.01	4.44309	44.43	80.0	1.90	0.93

8/27/2008

ZAVARIN Figure 11 - Open Circles = at 48 Hours

1E-7 M Pu(V);5g/L;Atm CO2;

Asp(m2/g)= 0.262

X_COORD	Y_COORD	Pu(V) % s	Kd	log Kd (ml	log Ka (mL/m2)
7.49	0.22366	2.24	4.6	0.66	1.24
7.75	1.42993	14.30	33.4	1.52	2.11
8.01	0.59597	5.96	12.7	1.10	1.68
8.26	1.76501	17.65	42.9	1.63	2.21
8.50	2.83724	28.37	79.2	1.90	2.48
8.75	3.09041	30.90	89.5	1.95	2.53
9.00	2.17454	21.75	55.6	1.74	2.33
9.24	2.29368	22.94	59.5	1.77	2.36
9.50	3.80524	38.05	122.9	2.09	2.67
9.75	0.86403	8.64	18.9	1.28	1.86

ZAVARIN Figure 11 - Closed Triangles = at 7 Days

1E-7 M Pu(V);5g/L;Atm CO2;

X_COORD	Y_COORD	Pu(V) % s	Kd	log Kd (ml	log Ka (mL/m2)
7.50	0.45449	4.54	9.5	0.98	1.56
7.75	1.05763	10.58	23.7	1.37	1.96
8.00	1.50439	15.04	35.4	1.55	2.13
8.25	3.49995	35.00	107.7	2.03	2.61
8.51	4.41582	44.16	158.2	2.20	2.78
8.75	4.37859	43.79	155.8	2.19	2.77
9.01	3.03084	30.31	87.0	1.94	2.52
9.25	4.76579	47.66	182.1	2.26	2.84
9.50	3.94671	39.47	130.4	2.12	2.70
9.75	0.45449	4.54	9.5	0.98	1.56

ZAVARIN Figure 12 - Open Circles = at 48 Hours

5E-9 M Pu(IV);5g/L;Atm CO2;

X_COORD	Y_COORD	Pu(IV) % s	Kd	log Kd (ml	log Ka (mL/m2)
7.51	7.79263	77.93	706.1	2.85	3.43
7.76	7.88570	78.86	745.9	2.87	3.45
8.01	8.43253	84.33	1075.9	3.03	3.61
8.26	8.37436	83.74	1030.3	3.01	3.59
8.51	8.50233	85.02	1135.4	3.06	3.64
8.77	8.13003	81.30	869.5	2.94	3.52
9.03	8.06022	80.60	831.0	2.92	3.50
9.26	8.03695	80.37	818.8	2.91	3.49
9.50	3.97650	39.77	132.0	2.12	2.70
9.76	2.33603	23.36	61.0	1.79	2.37

ZAVARIN Figure 12 - Closed Triangles = at 7 Days

5E-9 M Pu(IV);5g/L;Atm CO2;

X_COORD	Y_COORD	Pu(IV) % s	Kd	log Kd (ml	log Ka (mL/m2)
7.50	7.78099	77.81	701.3	2.85	3.43
7.76	7.62974	76.30	643.8	2.81	3.39
8.00	8.53724	85.37	1167.3	3.07	3.65
8.26	8.52560	85.26	1156.5	3.06	3.64
8.52	8.75829	87.58	1410.7	3.15	3.73
8.76	8.25801	82.58	948.1	2.98	3.56
9.01	8.26964	82.70	955.8	2.98	3.56
9.26	5.83803	58.38	280.5	2.45	3.03
9.51	6.51283	65.13	373.5	2.57	3.15
9.76	2.74324	27.43	75.6	1.88	2.46

Plutonium_data_pts - ZAVARIN

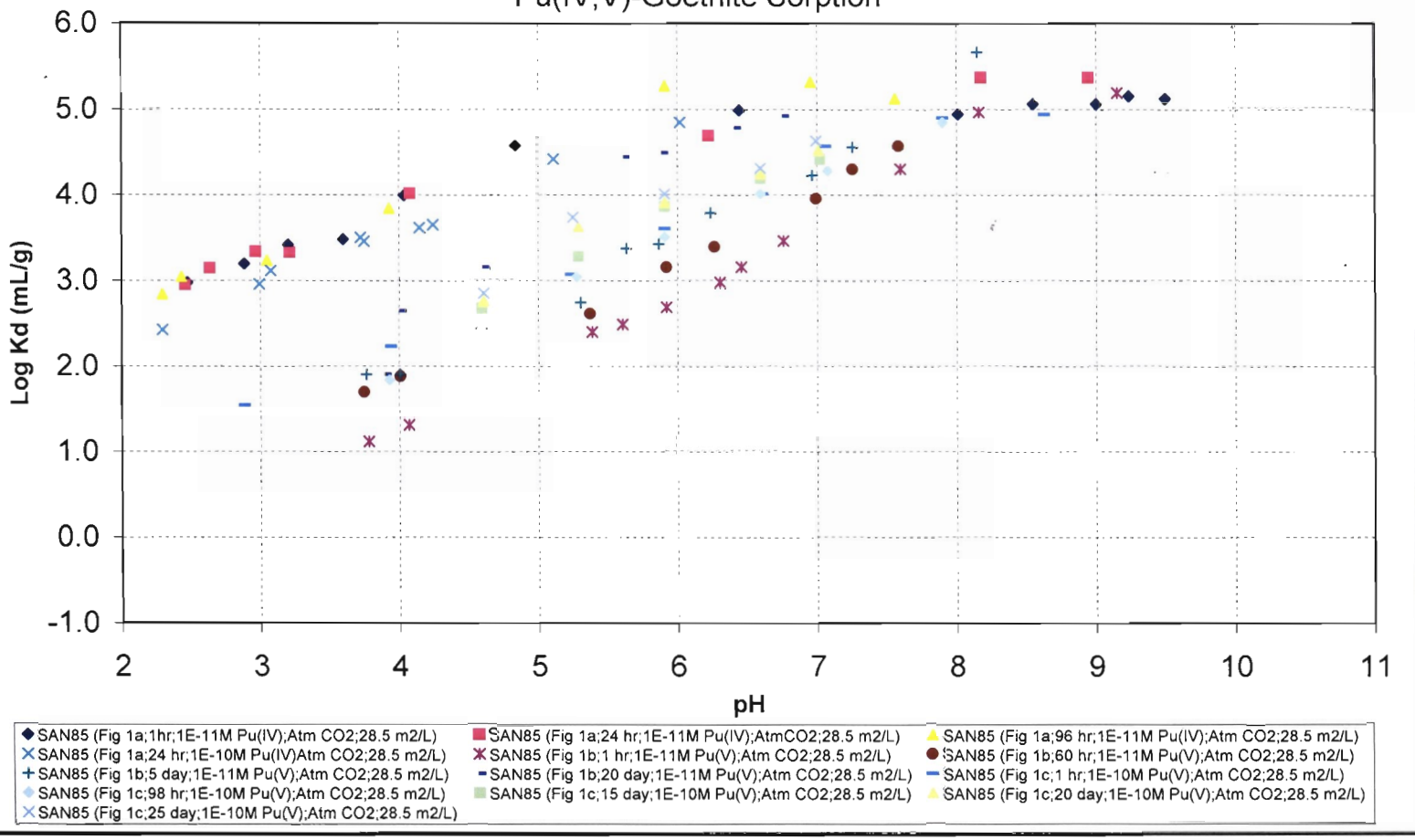
8/12/2009 DS

TITLE

Project No.

Book No.

Recorded by:



	Goe	Mn-Ox	Carb
KEEN85	X		X
SAN85	X		
SHAU03		X	
ZAV05			X

Plutonium_data_pts - Graphs - Log Kd

Date

Project No.

Book No.

2/16/10

Comparing DOE SCM modeling results to experimental data from the open literature

As described in the Safety Analysis Report and the supporting AMRs, DOE used a surface complexation model (SCM) within the USGS geochemistry code PHREEQCi to simulate sorption of Am, Np, Pu, U, and Th on stationary Fe corrosion products. Nickel was included in the SCM to represent competition for sorption sites, but the sorbed mass of nickel was not explicitly tracked for transport purposes.

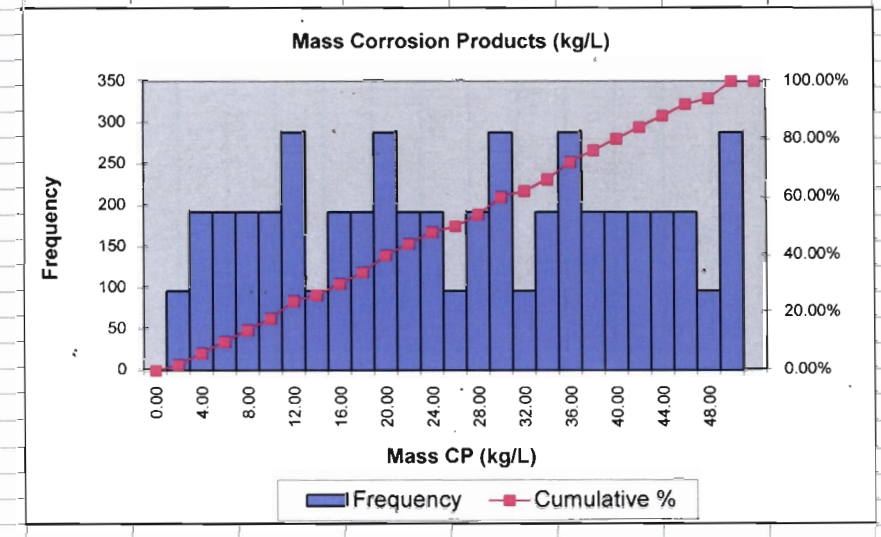
The SCM is not directly incorporated in the TSPA model abstraction, but the sorption coefficients (Kd) developed from the SCM are directly applicable to the transport of uranium, neptunium, and thorium, which are assumed to undergo rapid and reversible sorption. To represent parameter uncertainty in the SCM, the applicant conducted about 5,000 PHREEQC simulations, each with a unique combination of surface properties and aqueous chemistry parameters as inputs. The following graphs show comparison of the DOE SCM results to SCM sorption results to experimental data reported in the peer-reviewed scientific literature. The comparison was made for Np and Pu, the two principal drivers of dose to the RMEI.

2/16/10

soln	CP Mass (kg/L)
1	17.511
2	17.511
3	17.511
4	17.511
5	17.511
6	17.511
7	17.511
8	17.511
9	17.511
10	17.511
11	17.511
12	17.511
13	17.511
14	17.511
15	17.511
16	17.511
17	17.511
18	17.511
19	17.511
20	17.511
21	17.511
22	17.511
23	17.511
24	17.511
25	17.511
26	17.511
27	17.511
28	17.511
29	17.511
30	17.511
31	17.511
32	17.511
33	17.511
34	17.511
35	17.511
36	17.511
37	17.511
38	17.511
39	17.511
40	17.511
41	17.511
42	17.511
43	17.511
44	17.511
45	17.511

Mass Corrosion Products (kg/L)	
Mean	25.541
Standard Error	0.204
Median	25.785
Mode	17.511
Standard Deviation	14.113
Sample Variance	199.165
Kurtosis	-1.183
Skewness	0.003
Range	48.099
Minimum	1.484
Maximum	49.583
Sum	122596.906
Count	4800
Confidence Level(95.0%	0.39934063

	Bin	*Frequency*	*Cumulative %*
0.00	0.00	0	0.00%
2.00	2.00	96	2.00%
4.00	4.00	192	6.00%
6.00	6.00	192	10.00%
8.00	8.00	192	14.00%
10.00	10.00	192	18.00%
12.00	12.00	288	24.00%
14.00	14.00	96	26.00%
16.00	16.00	192	30.00%
18.00	18.00	192	34.00%
20.00	20.00	288	40.00%
22.00	22.00	192	44.00%
24.00	24.00	192	48.00%
26.00	26.00	96	50.00%
28.00	28.00	192	54.00%
30.00	30.00	288	60.00%
32.00	32.00	96	62.00%
34.00	34.00	192	66.00%
36.00	36.00	288	72.00%
38.00	38.00	192	76.00%
40.00	40.00	192	80.00%
42.00	42.00	192	84.00%
44.00	44.00	192	88.00%
46.00	46.00	192	92.00%
48.00	48.00	96	94.00%
50.00	50.00	288	100.00%



DOE
Mass of Corrosion Products
(sampled distribution,
DOE Reports using a
uniform distribution from
1 to 50 g/L

Project No.

Date

soln	pH	pCO2
1	7.29	2.80
2	7.56	2.65
3	7.14	3.31
4	7.45	2.79
5	6.51	2.43
6	7.63	2.52
7	7.42	2.46
8	8.13	3.24
9	7.58	2.38
10	8.00	3.24
11	7.60	2.92
12	6.97	2.42
13	8.00	3.67
14	6.76	2.40
15	7.44	2.95
16	7.44	3.49
17	7.43	3.87
18	8.83	3.41
19	7.06	2.10
20	7.75	3.80
21	8.06	3.86
22	7.83	3.71
23	8.00	2.86
24	7.44	3.29
25	8.77	3.50
26	8.80	3.96
27	7.52	2.49
28	7.68	2.14
29	6.97	3.28
30	7.47	2.29
31	7.06	2.83
32	8.04	3.38
33	7.97	3.96
35	7.01	2.58
36	7.72	3.07
37	7.43	2.85
38	7.29	3.12
39	8.63	3.40
40	8.06	3.43
41	6.57	2.36
42	9.14	3.97
43	8.32	3.14
44	7.66	2.01
45	7.35	2.59
46	7.49	2.19
47	7.46	3.20
48	7.55	3.65
49	8.61	2.23
50	7.50	3.52
51	7.52	2.48

pH stats

Mean	7.601
Standard Error	0.008
Median	7.562
Mode	7.632
Standard Deviation	0.529
Sample Variance	0.279
Kurtosis	0.584
Skewness	0.190
Range	2.911
Minimum	6.249
Maximum	9.160
Sum	36482.597
Count	4800.000
Confidence Level(95.0%	0.015

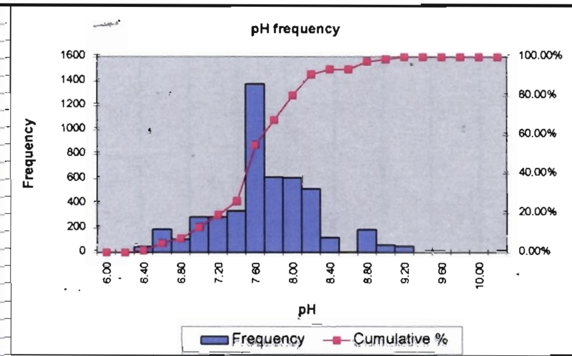
pH frequency

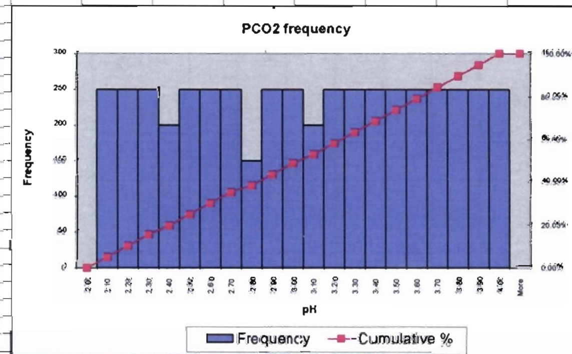
Bin	*Frequency*	*Cumulative %*
6.00	0	0.00%
6.20	0	0.00%
6.40	48	1.00%
6.60	189	4.94%
6.80	108	7.19%
7.00	290	13.23%
7.20	289	19.25%
7.40	340	26.33%
7.60	1378	55.04%
7.80	612	67.79%
8.00	608	80.46%
8.20	517	91.23%
8.40	121	93.75%
8.60	2	93.79%
8.80	187	97.69%
9.00	61	98.96%
9.20	50	100.00%
9.40	0	100.00%
9.60	0	100.00%
9.80	0	100.00%
10.00	0	100.00%
More	0	100.00%

PCO2 stats

Mean	3.013
Standard Error	0.008
Median	3.041
Mode	2.801
Standard Deviation	0.584
Sample Variance	0.341
Kurtosis	-1.223
Skewness	-0.046
Range	1.970
Minimum	2.010
Maximum	3.981
Sum	14462.710
Count	4800.000
Confidence Level(95.0%	0.017

	Bin	*Frequency*	*Cumulative %*
2.00	2.00	0	0.00%
2.10	2.10	250	5.21%
2.20	2.20	250	10.42%
2.30	2.30	250	15.63%
2.40	2.40	200	19.79%
2.50	2.50	250	25.00%
2.60	2.60	250	30.21%
2.70	2.70	250	35.42%
2.80	2.80	150	38.54%
2.90	2.90	250	43.75%
3.00	3.00	250	48.96%
3.10	3.10	200	53.13%
3.20	3.20	250	58.33%
3.30	3.30	250	63.54%
3.40	3.40	250	68.75%
3.50	3.50	250	73.96%
3.60	3.60	250	79.17%
3.70	3.70	250	84.38%
3.80	3.80	250	89.58%
3.90	3.90	250	94.79%
4.00	4.00	250	100.00%
	More	0	100.00%





CNWRA_pH_PCO2_stats

2/16/2010 DRS

pH values calculated by DOE using PHREEQC

P_{CO_2} sampled as PHREEQC input parameter. DOE reports sampling $\log P_{CO_2}$ from a uniform distribution:

$-4.0 < \log P_{CO_2} < -2.0$

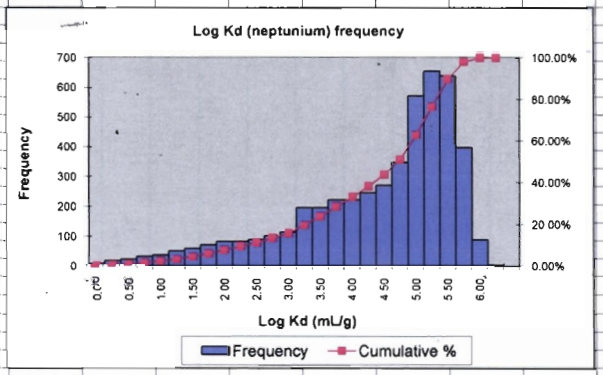
EBS Transport AMR Section 6.5.2.4.1 ANL-WIS-PA-000001 REV 03

Date ______ Verified by: ______ Date ______ Recorded by: ______

soln	pH	pCO2	CP Sp. Surf	>Np_CP	Np	CP Mass (kg/	Kd (mL/g)	logKd
1	7.290	2.801	46.370	4.631E-07	3.874E-13	17.511	68266.5	4.834
2	7.560	2.647	46.370	5.618E-02	3.040E-08	17.511	105542.1	5.023
3	7.137	3.315	46.370	2.058E-06	2.206E-08	17.511	5.3	0.727
4	7.451	2.791	46.370	9.632E-01	5.858E-07	17.511	93898.3	4.973
5	6.514	2.432	46.370	1.562E-04	6.659E-07	17.511	13.4	1.127
6	7.631	2.517	46.370	1.397E-02	8.306E-09	17.511	96066.4	4.983
7	7.420	2.456	46.370	2.209E-05	1.292E-11	17.511	97694.2	4.990
8	8.132	3.244	46.370	5.842E-02	4.472E-08	17.511	74597.9	4.873
9	7.578	2.376	46.370	2.236E-06	1.534E-12	17.511	83220.7	4.920
10	7.995	3.239	46.370	1.328E+00	7.289E-07	17.511	104050.2	5.017
11	7.600	2.922	46.370	7.834E-05	6.989E-11	17.511	64008.7	4.806
12	6.970	2.415	46.370	2.808E-04	6.560E-10	17.511	24441.7	4.388
13	8.004	3.675	46.370	6.641E-07	1.709E-13	17.511	221866.2	5.346
14	6.763	2.398	46.370	1.015E-05	4.494E-10	17.511	1289.5	3.110
15	7.442	2.950	46.370	6.893E-05	4.645E-11	17.511	84749.4	4.928
16	7.445	3.488	46.370	4.822E-06	8.551E-12	17.511	32206.3	4.508
17	7.428	3.871	46.370	7.400E-04	2.890E-09	17.511	14623.1	4.165
18	8.832	3.414	46.370	6.488E-02	5.881E-06	17.511	630.0	2.799
19	7.064	2.105	46.370	5.736E-02	9.550E-08	17.511	34309.9	4.535
20	7.745	3.803	46.370	6.647E-08	5.006E-13	17.511	7582.0	3.880
21	8.063	3.858	46.370	4.650E-01	1.885E-06	17.511	14083.6	4.149
22	7.825	3.706	46.370	2.045E-07	8.745E-14	17.511	133554.5	5.126
23	8.001	2.864	46.370	1.680E-01	2.066E-07	17.511	46422.4	4.667
24	7.437	3.289	46.370	1.161E-05	2.505E-11	17.511	26461.0	4.423
25	8.768	3.504	46.370	8.372E-08	2.379E-12	17.511	2010.0	3.303
26	8.803	3.981	46.370	9.600E-10	1.911E-14	17.511	2869.1	3.458
27	7.523	2.485	46.370	6.719E-02	6.051E-08	17.511	63415.2	4.802
28	7.675	2.141	46.370	1.662E+00	4.885E-06	17.511	19428.9	4.288
29	6.975	3.279	46.370	1.925E-10	3.954E-13	17.511	27.8	1.444
30	7.473	2.295	46.370	1.619E-03	1.360E-09	17.511	67964.9	4.832
31	7.056	2.828	46.370	2.622E-06	1.262E-10	17.511	1186.7	3.074
32	8.045	3.379	46.370	2.683E-05	1.084E-11	17.511	141371.1	5.150
33	7.971	3.956	46.370	3.329E-01	9.603E-08	17.511	197972.8	5.297
35	7.006	2.579	46.370	7.002E-03	4.451E-08	17.511	8982.9	3.953
36	7.718	3.068	46.370	4.297E-02	1.471E-08	17.511	166783.2	5.222
37	7.434	2.854	46.370	4.108E-01	2.198E-07	17.511	106734.2	5.028
38	7.292	3.115	46.370	9.355E-06	3.433E-09	17.511	155.6	2.192
39	8.625	3.399	46.370	4.394E-09	1.663E-13	17.511	1508.8	3.179
40	8.061	3.426	46.370	7.741E-01	3.026E-07	17.511	146078.4	5.165
41	6.566	2.358	46.370	1.530E-04	1.109E-07	17.511	78.8	1.896
42	9.144	3.973	46.370	5.919E-07	2.811E-11	17.511	1202.4	3.080
43	8.317	3.142	46.370	5.774E-01	2.672E-06	17.511	12340.5	4.091
44	7.660	2.010	46.370	1.972E+00	1.047E-05	17.511	10757.1	4.032
45	7.351	2.591	46.370	3.225E-04	5.571E-10	17.511	33062.7	4.519
46	7.494	2.192	46.370	8.894E-01	1.816E-06	17.511	27965.2	4.447
47	7.460	3.205	46.370	4.551E-02	6.046E-08	17.511	42985.8	4.633
48	7.547	3.653	46.370	8.679E-08	7.601E-14	17.511	65204.1	4.814
49	6.607	2.227	46.370	5.244E-07	5.128E-11	17.511	584.0	2.766
50	7.500	3.520	46.370	2.039E-01	3.773E-07	17.511	30861.2	4.489

Log Kd (neptunium) stats	
Mean	4.267
Standard Error	0.018
Median	4.713
Mode	#N/A
Standard Deviation	1.267
Sample Variance	1.606
Kurtosis	0.677
Skewness	-1.148
Range	6.263
Minimum	-0.250
Maximum	6.013
Sum	20481.843
Count	4800
Confidence Level(95.0%	0.03586122

Bin	Frequency	Cumulative %
0.00	7	0.15%
0.25	16	0.48%
0.50	22	0.94%
0.75	32	1.60%
1.00	36	2.35%
1.25	50	3.40%
1.50	58	4.60%
1.75	70	6.06%
2.00	82	7.77%
2.25	82	9.46%
2.50	89	11.33%
2.75	101	13.44%
3.00	113	15.79%
3.25	195	19.85%
3.50	195	23.92%
3.75	221	28.52%
4.00	221	33.13%
4.25	245	38.23%
4.50	269	43.83%
4.75	346	51.04%
5.00	571	62.94%
5.25	654	76.56%
5.50	638	89.85%
5.75	396	98.10%
6.00	88	99.94%
More	3	100.00%



$$\frac{0.56}{10^{-0.250}} < K_d < \frac{1,030,386}{10^{6.013}}$$

CNWRA_Kd_Np_plots

Summary Statistics for Kd (Np) values calculated by DOE using SCM in PHREEQC

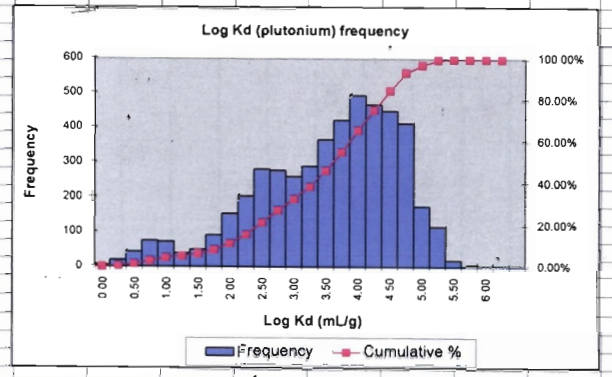
4,800 realizations based on sampling input parameters

Project No. Book No. Date

soln	pH	pCO2	CP Sp. Surf	>Pu_CP	Pu	CP Mass (kg/	Kd (mL/g)	logKd
1	7.290	2.801	46.370	5.277E-08	3.671E-13	17.511	8209.3	3.914
2	7.560	2.647	46.370	1.008E-03	1.006E-08	17.511	5717.5	3.757
3	7.137	3.315	46.370	1.639E-09	3.015E-11	17.511	3.1	0.492
4	7.451	2.791	46.370	4.207E-09	2.993E-14	17.511	8028.1	3.905
5	6.514	2.432	46.370	3.119E-12	4.468E-16	17.511	4.0	0.601
6	7.631	2.517	46.370	2.281E-07	3.281E-12	17.511	3969.9	3.599
7	7.420	2.456	46.370	8.340E-03	1.044E-07	17.511	4561.8	3.659
8	8.132	3.244	46.370	6.331E-06	5.836E-11	17.511	6195.3	3.792
9	7.578	2.376	46.370	9.476E-09	1.827E-13	17.511	2962.6	3.472
10	7.995	3.239	46.370	4.457E-07	2.767E-12	17.511	9199.7	3.964
11	7.600	2.922	46.370	2.708E-05	2.831E-10	17.511	5462.4	3.737
12	6.970	2.415	46.370	7.603E-04	1.749E-08	17.511	2483.3	3.395
13	8.004	3.675	46.370	6.312E-09	8.563E-15	17.511	42096.4	4.624
14	6.763	2.398	46.370	4.599E-09	1.319E-12	17.511	199.1	2.299
15	7.442	2.950	46.370	2.301E-04	1.271E-09	17.511	10338.6	4.014
16	7.445	3.488	46.370	3.833E-05	1.704E-10	17.511	12844.6	4.109
17	7.428	3.871	46.370	6.932E-04	2.771E-09	17.511	14287.0	4.155
18	8.832	3.414	46.370	2.002E-09	9.395E-13	17.511	121.7	2.085
19	7.064	2.105	46.370	4.475E-06	1.741E-10	17.511	1467.6	3.167
20	7.745	3.803	46.370	3.019E-06	5.491E-11	17.511	3139.7	3.497
21	8.063	3.858	46.370	1.349E-07	2.230E-12	17.511	3455.0	3.538
22	7.825	3.706	46.370	1.252E-05	1.878E-11	17.511	38066.2	4.581
23	8.001	2.864	46.370	1.449E-08	3.061E-13	17.511	2703.9	3.432
24	7.437	3.289	46.370	4.395E-07	3.652E-12	17.511	6873.0	3.837
25	8.768	3.504	46.370	1.321E-03	2.220E-07	17.511	339.9	2.531
26	8.803	3.981	46.370	1.503E-07	1.766E-11	17.511	486.0	2.687
27	7.523	2.485	46.370	3.746E-09	7.819E-14	17.511	2736.1	3.437
28	7.675	2.141	46.370	1.349E-07	1.177E-11	17.511	654.4	2.816
29	6.975	3.279	46.370	1.617E-04	4.603E-07	17.511	20.1	1.303
30	7.473	2.295	46.370	2.101E-06	5.200E-13	17.511	2307.1	3.363
31	7.056	2.828	46.370	3.860E-09	8.736E-13	17.511	252.4	2.402
32	8.045	3.379	46.370	1.179E-04	4.542E-10	17.511	14819.0	4.171
33	7.971	3.956	46.370	1.298E-03	1.034E-06	17.511	71681.8	4.855
35	7.006	2.579	46.370	1.690E-08	7.952E-13	17.511	1213.6	3.084
36	7.718	3.068	46.370	1.353E-02	4.964E-08	17.511	15567.6	4.192
37	7.434	2.854	46.370	2.621E-09	1.392E-14	17.511	10752.6	4.032
38	7.292	3.115	46.370	2.580E-09	3.921E-12	17.511	37.6	1.575
39	8.625	3.399	46.370	2.620E-04	6.957E-08	17.511	215.0	2.333
40	8.061	3.426	46.370	1.299E-02	4.568E-08	17.511	16242.9	4.211
41	6.566	2.358	46.370	1.007E-06	3.308E-09	17.511	17.4	1.240
42	9.144	3.973	46.370	4.077E-07	1.131E-10	17.511	205.9	2.314
43	8.317	3.142	46.370	1.255E-04	6.489E-09	17.511	1104.0	3.043
44	7.660	2.010	46.370	3.174E-08	4.886E-12	17.511	371.0	2.569
45	7.351	2.591	46.370	2.594E-02	6.559E-07	17.511	2258.3	3.354
46	7.494	2.192	46.370	1.242E-07	8.515E-12	17.511	832.9	2.921
47	7.460	3.205	46.370	2.061E-04	1.335E-09	17.511	8818.5	3.945
48	7.547	3.653	46.370	7.400E-07	1.410E-12	17.511	29974.4	4.477
49	6.607	2.227	46.370	1.643E-03	1.077E-06	17.511	87.1	1.940
50	7.506	3.520	46.370	2.664E-02	1.299E-07	17.511	11706.2	4.068

Log Kd (Plutonium) Stats	
Mean	3.384
Standard Error	0.016
Median	3.599
Mode	#N/A
Standard Deviation	1.109
Sample Variance	1.229
Kurtosis	0.043
Skewness	-0.728
Range	5.726
Minimum	-0.187
Maximum	5.539
Sum	16241.447
Count	4800
Confidence Level(95.0%	0.031

	Bin	Frequency	Cumulative %
0.00	0.00	5	0.10%
0.25	0.25	20	0.52%
0.50	0.50	44	1.44%
0.75	0.75	76	3.02%
1.00	1.00	73	4.54%
1.25	1.25	40	5.38%
1.50	1.50	50	6.42%
1.75	1.75	93	8.35%
2.00	2.00	154	11.56%
2.25	2.25	204	15.81%
2.50	2.50	282	21.69%
2.75	2.75	278	27.48%
3.00	3.00	261	32.92%
3.25	3.25	290	38.96%
3.50	3.50	367	46.60%
3.75	3.75	423	55.42%
4.00	4.00	495	65.73%
4.25	4.25	468	75.48%
4.50	4.50	450	84.85%
4.75	4.75	414	93.48%
5.00	5.00	176	97.15%
5.25	5.25	117	99.58%
5.50	5.50	19	99.98%
5.75	5.75	1	100.00%
6.00	6.00	0	100.00%
6.25	More	0	100.00%



$0.65 < K_d < 345,439$

$10^{-0.187}$ $10^{5.539}$

CNWRA_Kd_Pu_plots

Summary statistics for K_d, Pu calculated by DOE SCM using PHREEQC.

2/14/10 DRJ

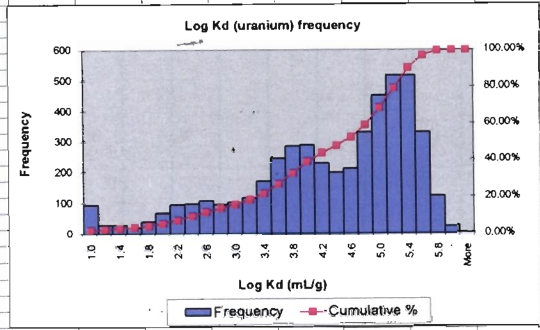
30 Project No. _____ Book No. _____ Recorded by:

pH	pCO2	CP □Sp. Surf	>U_CP	U	CP Mass (kg/	Kd (mL/g)	logKd
7.290	2.801	46.370	5.365E+00	4.758E-06	17.511	64389.1	4.809
7.560	2.647	46.370	2.050E-01	1.196E-07	17.511	97894.9	4.991
7.137	3.315	46.370	1.160E+01	1.025E-01	17.511	6.5	0.810
7.451	2.791	46.370	1.632E+00	1.690E-06	17.511	55147.2	4.742
6.514	2.432	46.370	1.161E+01	6.419E-03	17.511	103.3	2.014
7.631	2.517	46.370	5.362E-02	1.741E-08	17.511	175893.6	5.245
7.420	2.456	46.370	4.442E-01	2.364E-07	17.511	107335.0	5.031
8.132	3.244	46.370	3.863E-03	3.269E-09	17.511	67486.1	4.829
7.578	2.376	46.370	1.146E-02	3.210E-09	17.511	203926.7	5.309
7.995	3.239	46.370	3.032E-01	3.030E-07	17.511	57135.2	4.757
7.600	2.922	46.370	8.952E-03	1.971E-08	17.511	25936.0	4.414
6.970	2.415	46.370	7.804E+00	8.825E-06	17.511	50505.5	4.703
8.004	3.675	46.370	1.522E-02	4.714E-08	17.511	18436.8	4.266
6.763	2.398	46.370	1.134E+01	1.098E-04	17.511	5894.2	3.770
7.442	2.950	46.370	1.775E+00	2.110E-06	17.511	48027.1	4.681
7.445	3.488	46.370	6.878E-07	1.171E-10	17.511	335.3	2.525
7.428	3.871	46.370	4.340E-01	3.995E-06	17.511	6204.6	3.793
8.832	3.414	46.370	9.430E-03	1.663E-07	17.511	3238.2	3.510
7.064	2.105	46.370	1.394E+00	1.845E-06	17.511	43144.3	4.635
7.745	3.803	46.370	1.123E+01	1.721E-04	17.511	3725.3	3.571
8.063	3.858	46.370	9.729E+00	1.506E-04	17.511	3689.9	3.567
7.825	3.706	46.370	4.325E-06	8.113E-11	17.511	3044.1	3.483
8.001	2.864	46.370	4.267E-03	2.483E-09	17.511	98124.3	4.992
7.437	3.289	46.370	3.092E-05	2.021E-09	17.511	874.0	2.942
8.768	3.504	46.370	5.477E-04	5.204E-09	17.511	6009.7	3.779
8.803	3.981	46.370	1.300E+00	5.492E-05	17.511	1352.0	3.131
7.523	2.485	46.370	1.877E-02	1.215E-08	17.511	88224.2	4.946
7.675	2.141	46.370	1.912E-02	6.188E-09	17.511	176503.2	5.247
6.975	3.279	46.370	1.162E+01	1.114E-02	17.511	59.6	1.775
7.473	2.295	46.370	9.386E-02	3.567E-08	17.511	150271.6	5.177
7.056	2.828	46.370	1.146E+01	2.253E-04	17.511	2903.1	3.463
8.045	3.379	46.370	1.587E-02	1.642E-08	17.511	55204.0	4.742
7.971	3.956	46.370	1.595E-05	4.048E-10	17.511	2249.8	3.352
7.006	2.579	46.370	1.031E+01	2.772E-05	17.511	21245.9	4.327
7.718	3.068	46.370	3.176E-01	2.848E-07	17.511	63692.6	4.804
7.434	2.854	46.370	2.136E+00	1.959E-06	17.511	62276.2	4.794
7.292	3.115	46.370	1.147E+01	2.653E-03	17.511	247.0	2.393
8.625	3.399	46.370	2.373E-03	3.215E-08	17.511	4214.9	3.625
8.061	3.426	46.370	2.959E-03	3.362E-09	17.511	50259.9	4.701
6.566	2.358	46.370	1.159E+01	1.107E-03	17.511	598.3	2.777
9.144	3.973	46.370	2.235E-02	1.007E-06	17.511	1267.3	3.103
8.317	3.142	46.370	2.726E-01	4.988E-07	17.511	31205.5	4.494
7.660	2.010	46.370	3.730E-02	1.307E-08	17.511	162943.1	5.212
7.351	2.591	46.370	6.183E-01	1.482E-06	17.511	23826.2	4.377
7.494	2.192	46.370	5.591E-02	3.359E-08	17.511	95064.9	4.978
7.460	3.205	46.370	2.567E-06	6.024E-11	17.511	2433.9	3.386
7.547	3.653	46.370	8.992E-08	1.188E-11	17.511	432.2	2.636
6.607	2.227	46.370	1.144E+01	1.685E-04	17.511	3876.0	3.588
7.500	3.520	46.370	2.299E-02	3.146E-07	17.511	4173.7	3.621
7.516	2.477	46.370	7.760E-02	3.902E-08	17.511	113565.6	5.055
8.075	3.838	46.370	1.110E+01	4.661E-03	17.511	136.1	2.134

Log Kd (uranium) Stats

Mean	4.171
Standard Error	0.017
Median	4.506
Mode	#N/A
Standard Deviation	1.210
Sample Variance	1.465
Kurtosis	1.450
Skewness	-1.179
Range	7.014
Minimum	-1.034
Maximum	5.980
Sum	20020.658
Count	4800.000
Confidence Level(95.0%	0.034

Bin	*Frequency*	*Cumulative %*
1.0	93	1.94%
1.2	28	2.52%
1.4	28	3.10%
1.6	20	3.52%
1.8	39	4.33%
2.0	67	5.73%
2.2	94	7.69%
2.4	96	9.69%
2.6	107	11.92%
2.8	94	13.88%
3.0	102	16.00%
3.2	116	18.42%
3.4	170	21.96%
3.6	244	27.04%
3.8	285	32.98%
4.0	289	39.00%
4.2	229	43.77%
4.4	198	47.90%
4.6	211	52.29%
4.8	331	59.19%
5.0	451	68.58%
5.2	516	79.33%
5.4	516	90.08%
5.6	331	96.98%
5.8	122	99.52%
6.0	23	100.00%
More	0	100.00%



954,993

$0.09 < K_d <$ ~~125,314~~

$10^{-1.034}$ $10^{+5.980}$

Summary statistics for $K_{d,U}$ calculated by DDE SCM using PHREEQC w/ input parameter sampling
4800 realizations

CNWRA_Kd_U_plots

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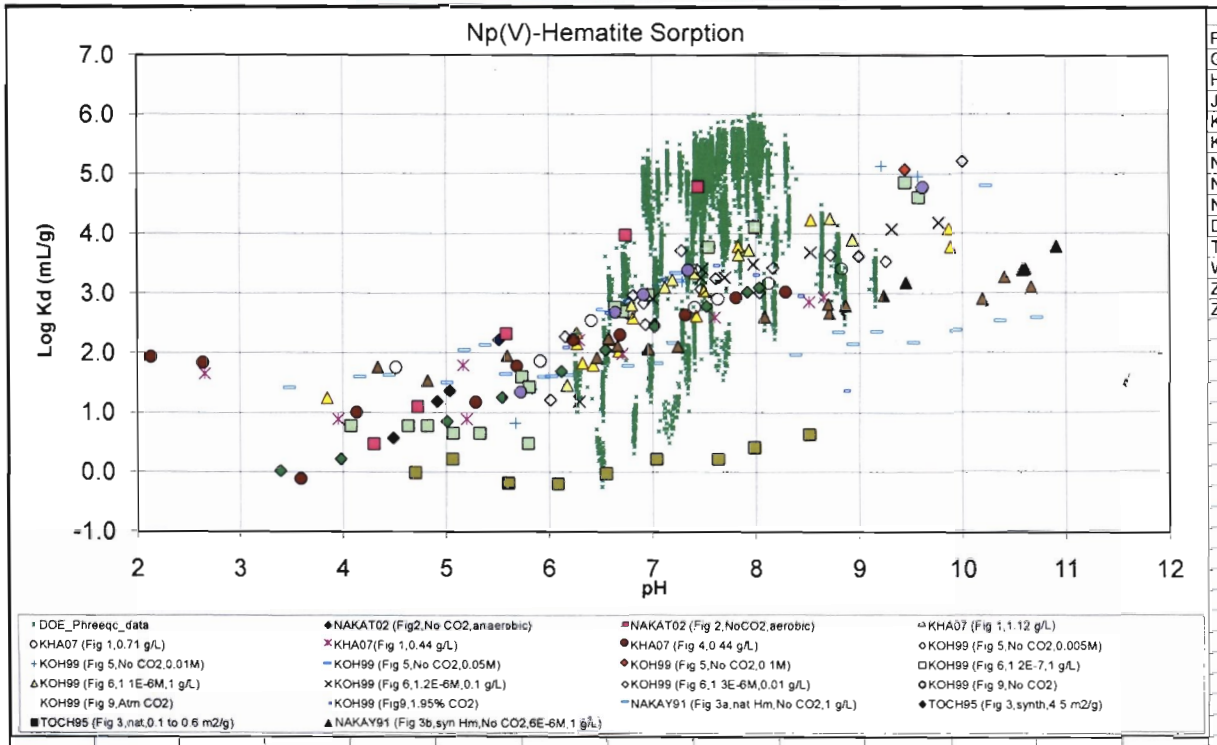
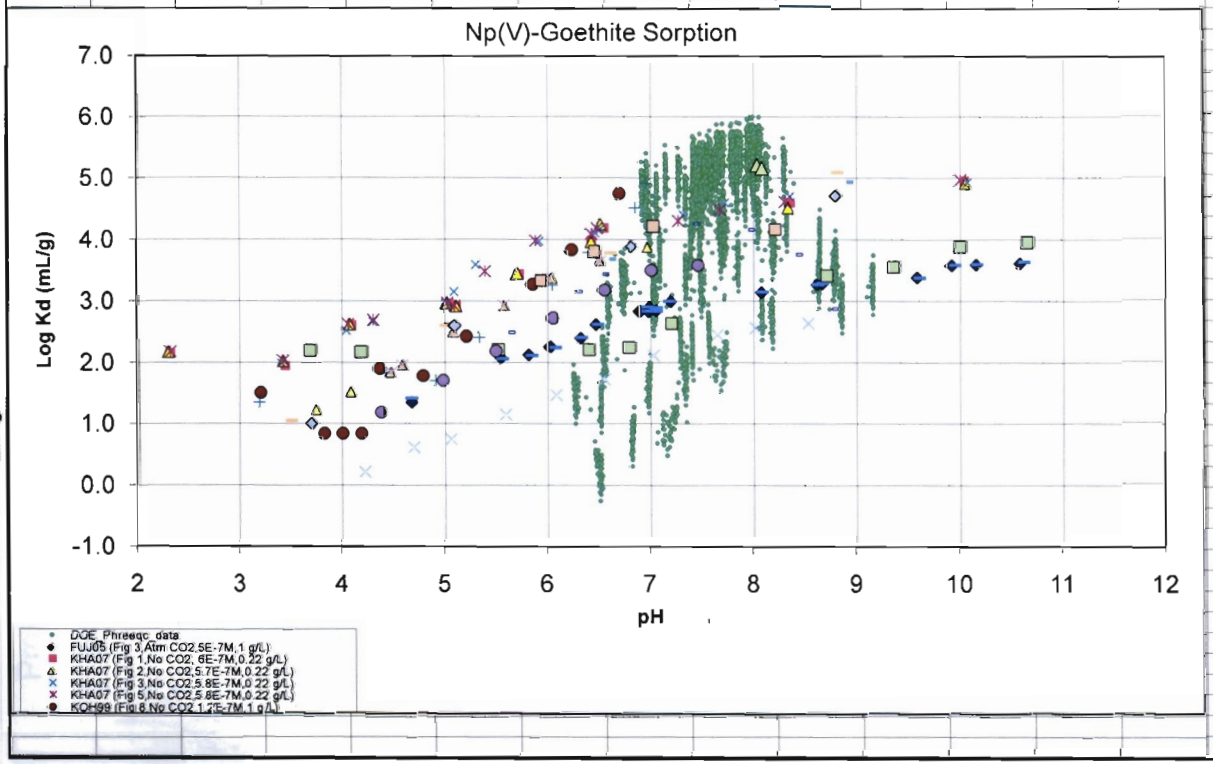


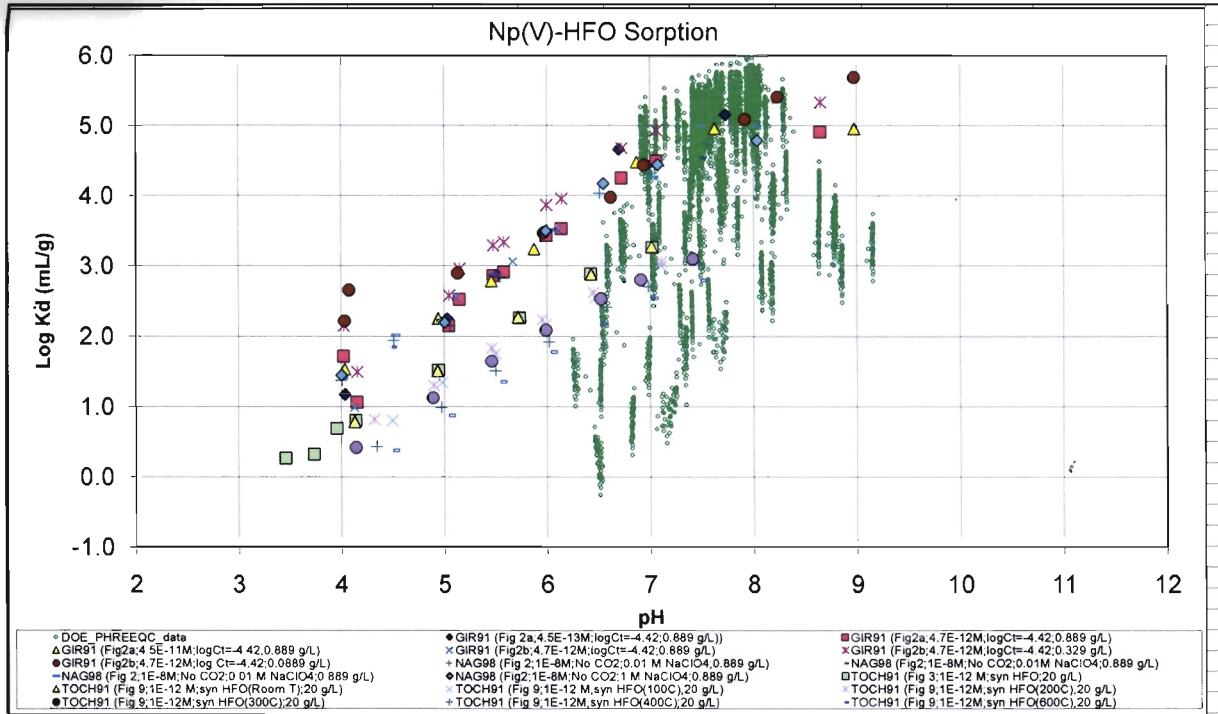


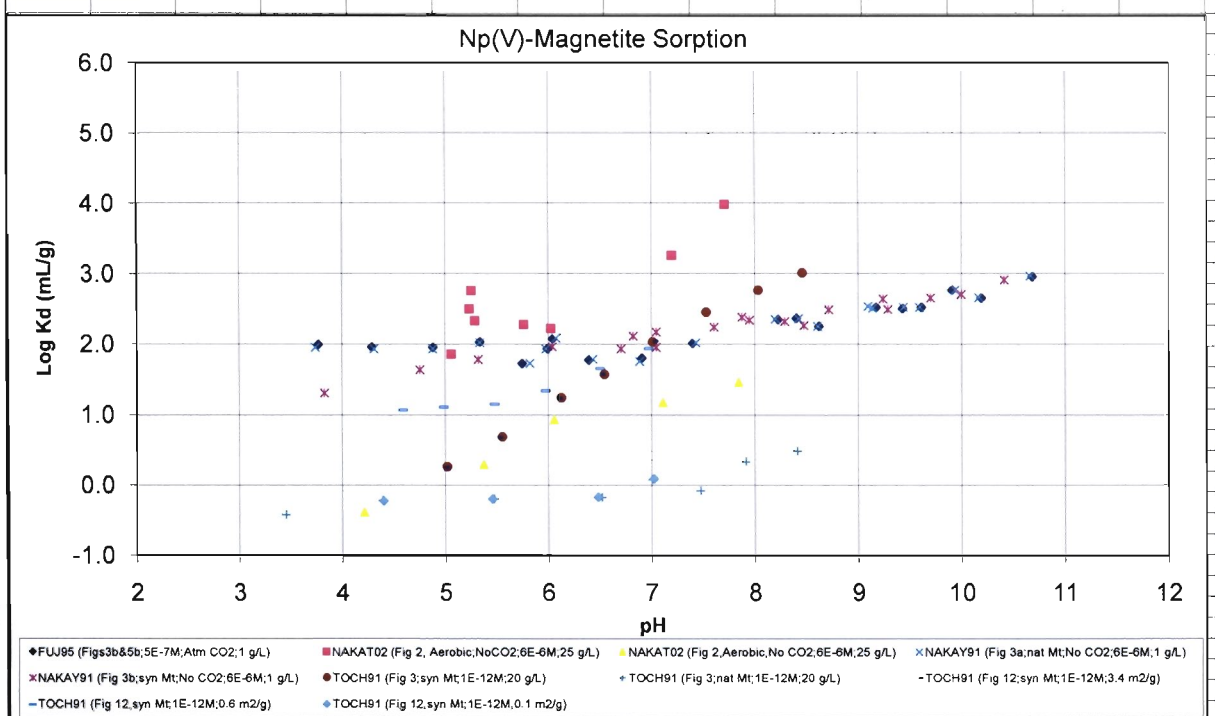
	Hm	Goe	HFO	Mt	SiO2	Al-oxide	Al-Silicate	Cc
FUJ95		X		X				
GIR91			X					
HEB08								X
JER07		X						
KHA07	X	X						
KOH99	X	X			X			
NAG98			X					
NAKAT02	X			X				
NAKAY91	X	X		X		X	X(bt)	
DELNER04							X	
TOCH95	X	X	X	X				
WILK05								
ZAV05								X
ZUYI04					X	X		

Comparison of DOE calculations (K_d, Np using SCM) to experimental Np-Fe(hydr)oxide sorption data

Np(V) - Hematite

Np(V) - Goethite





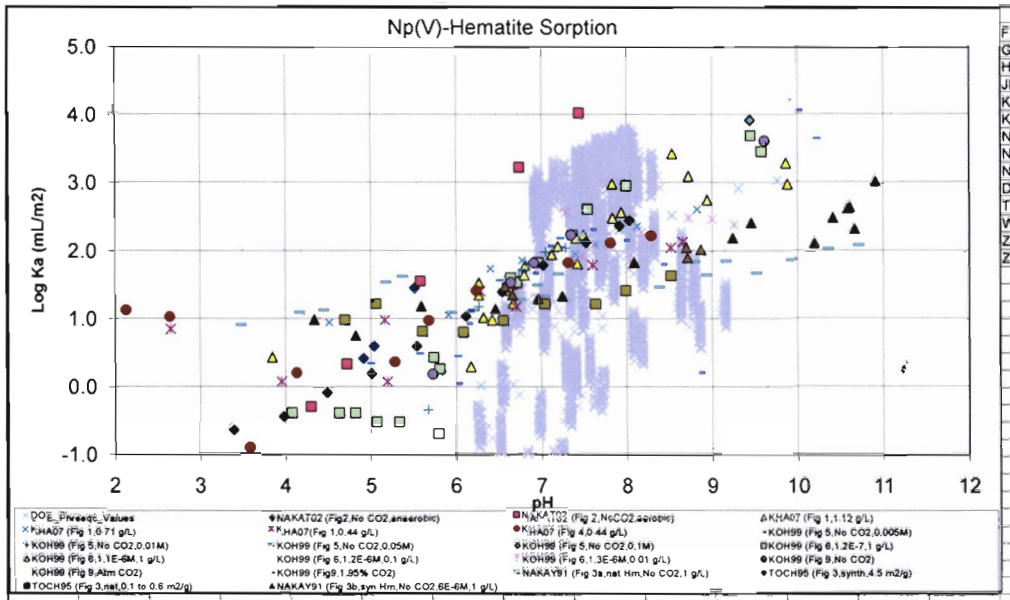
Same as pg. 32

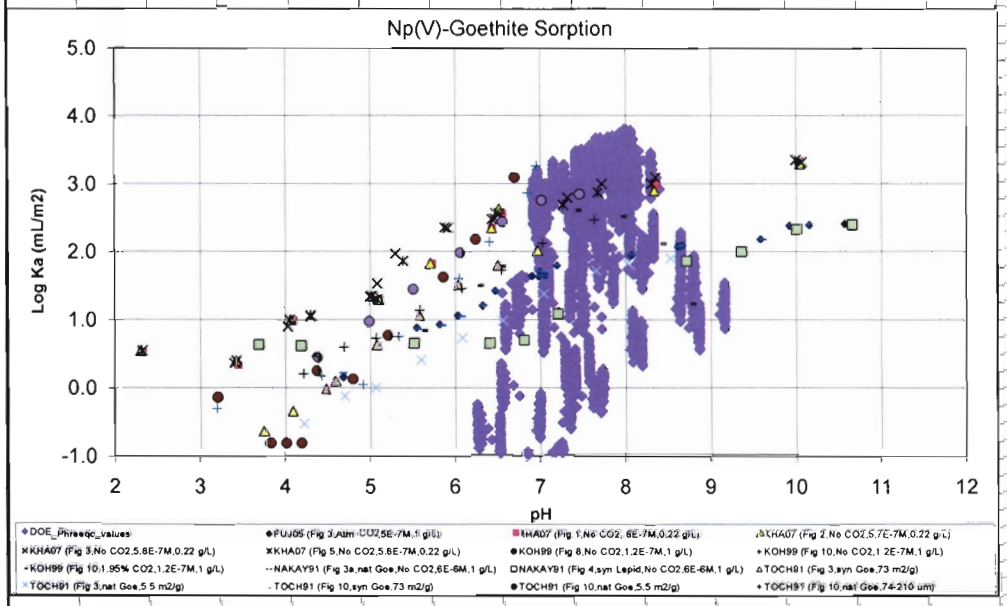
Np(V)-HFO

Np(V)-Mt

Neptunium data pts - Graphs - Log Kd

2/16/10



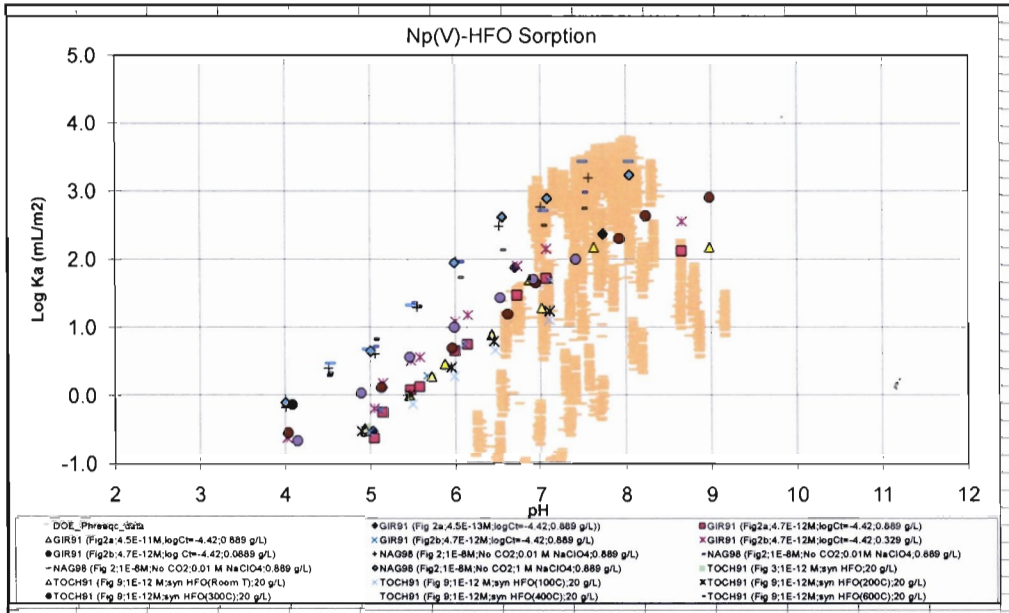


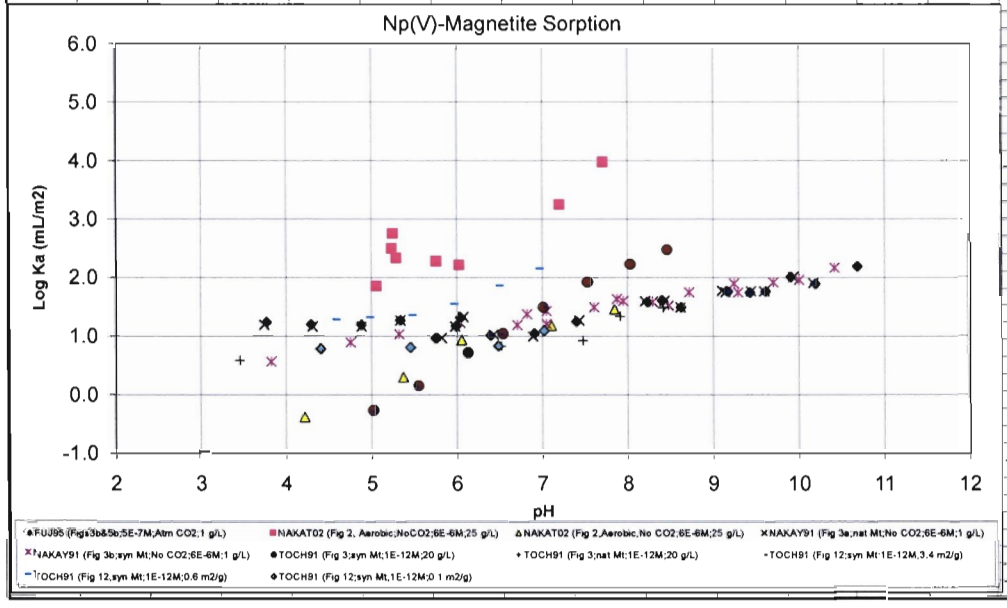
	Hm	Goe	HFO	Mt	SiO2	Al-oxide	Al-Silicate	Cc
FUJ05		X		X				
GIR91			X					
HEB08								X
JER07		X						
KHA07	X	X						
KOH99	X	X			X			
NAG98			X					
NAKAT02	X			X				
NAKAY91	X	X		X		X	X(bt)	
DELNER04							X	
TOCH95	X	X	X	X				
WILK05								
ZAV05								
ZUY04					X	X		

Comparison SAM to Experimental
Data normalized to SA_{sp}
DOE data normalized using sample
SA_{sp} for individual PHREEQC simulations

Neptunium data pts - Graphs - Log Ka

2/16/10

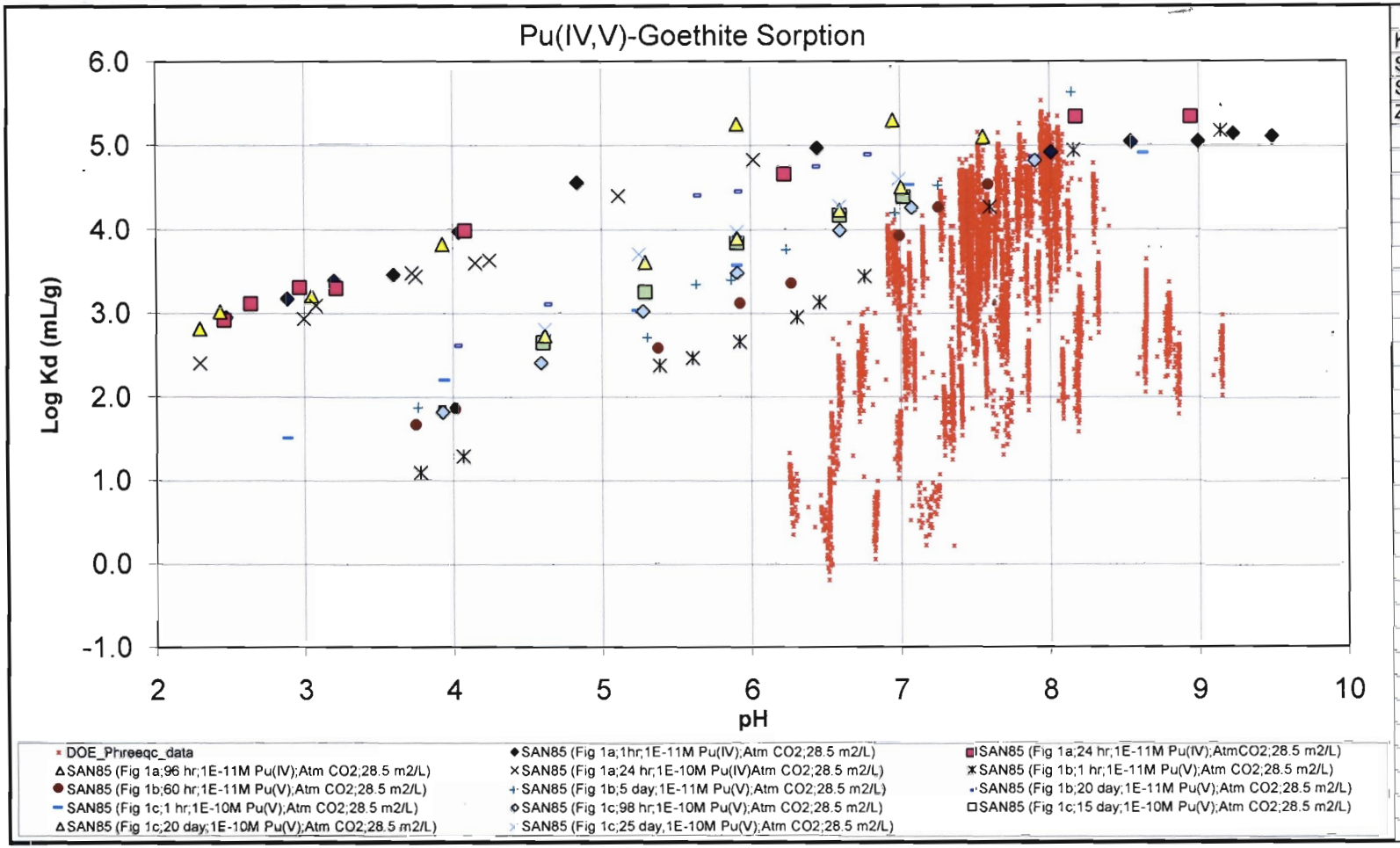




Normalized for SA, surfaces sites and sampled for individual DOE PHREEQC runs.

Neptunium data pts - Graphs - Log Ka

2/16/2010



	Goe	Mn-Ox	Carb
KEEN85	X		X
SAN85	X		
SHAU03		X	
ZAV05			X

Plutonium_data_pts - Graphs - Log Kd

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2/16/2010 (JD)

Comparison of calculated Kd (DOE PHREEQC sim) to experimental data of Sanchez et al (1985)

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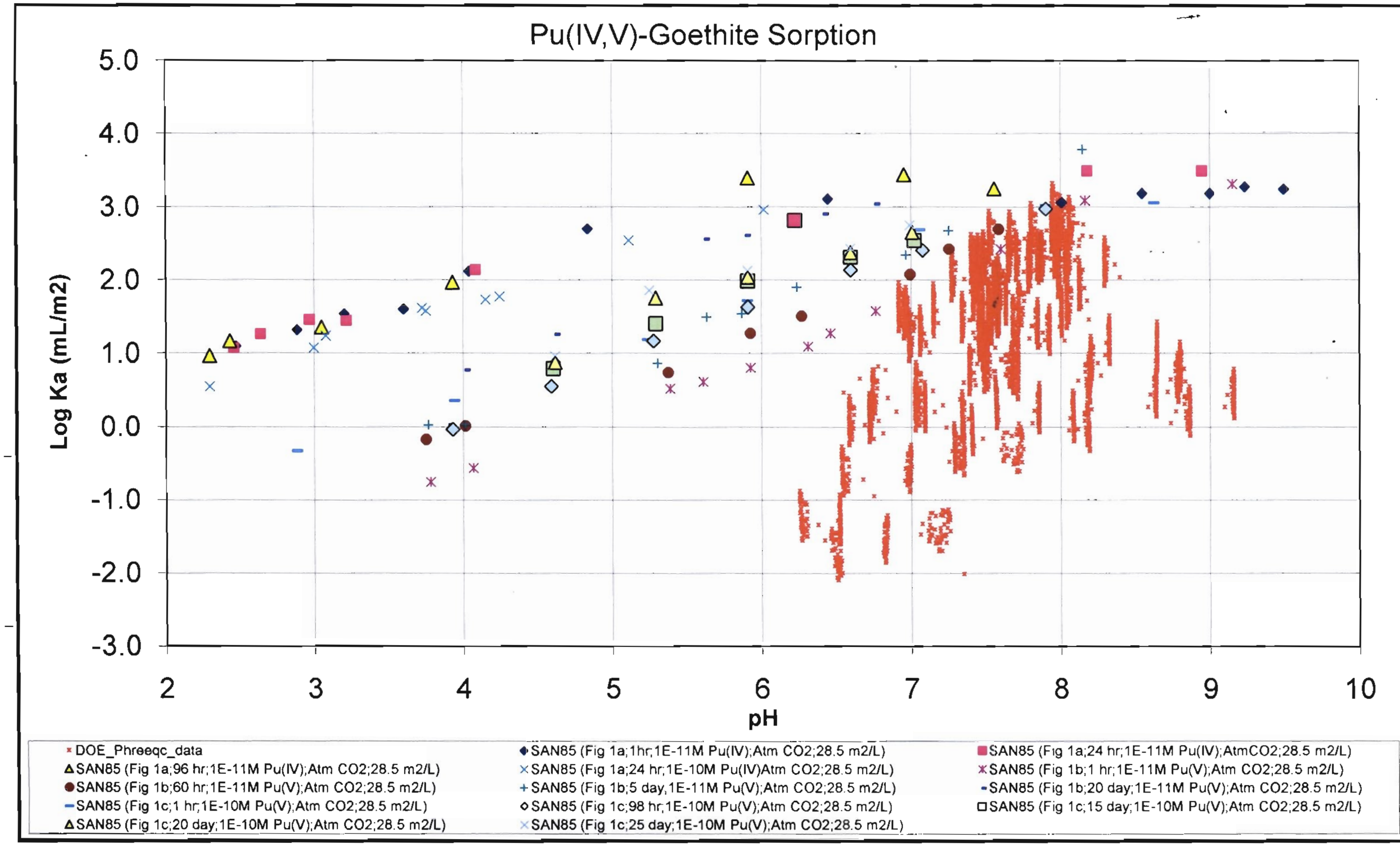

	Goe	Mn-Ox	Carb
KEEN85	X		X
SAN85	X		
SHAU03		X	
ZAV05			X

Plutonium_data_pts - Graphs - Log Ka

Comparison of $K_{d,Pu}$ calculated w/ DOE SCM to Pu(IV,V)-Goethite sorption data of Sanchez et al (1985) normalized to surface area (N_2-BET) for experiments & sampled SA/SP from individual DOE SCM realizations

2/16/2010

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No further entries.
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