CONTROLLED COPY NO. 823

The Boorum & Pease® Quality Guarantee

The materials and craftsmanship that went into this product are of the finest quality. The pages are thread sewn, meaning they're bound to stay bound. The inks are moisture resistant and will not smear. And the uniform quality of the paper assures consistent rulings, excellent writing surface and erasability. If, at any time during normal use, this product does not perform to your expectations, we will replace it free of charge. Simply write to us:

Boorum & Pease Company
71 Clinton Road, Garden City, NY 11530
Attn: Marketing Services

Any correspondence should include the book title stamped at the bottom of the spine.

One Good Book Deserves Many Others.

Look for the complete line of Boorum & Pease® Columnar, Journal, and Record books. Custom-designed books also available by special order. For more information about our Customized Book Program, contact your office products dealer. See back cover for other books in this series.

Made in Canada
B111701

Contents

Page

James D. Prikryl jp CNWRA x5667

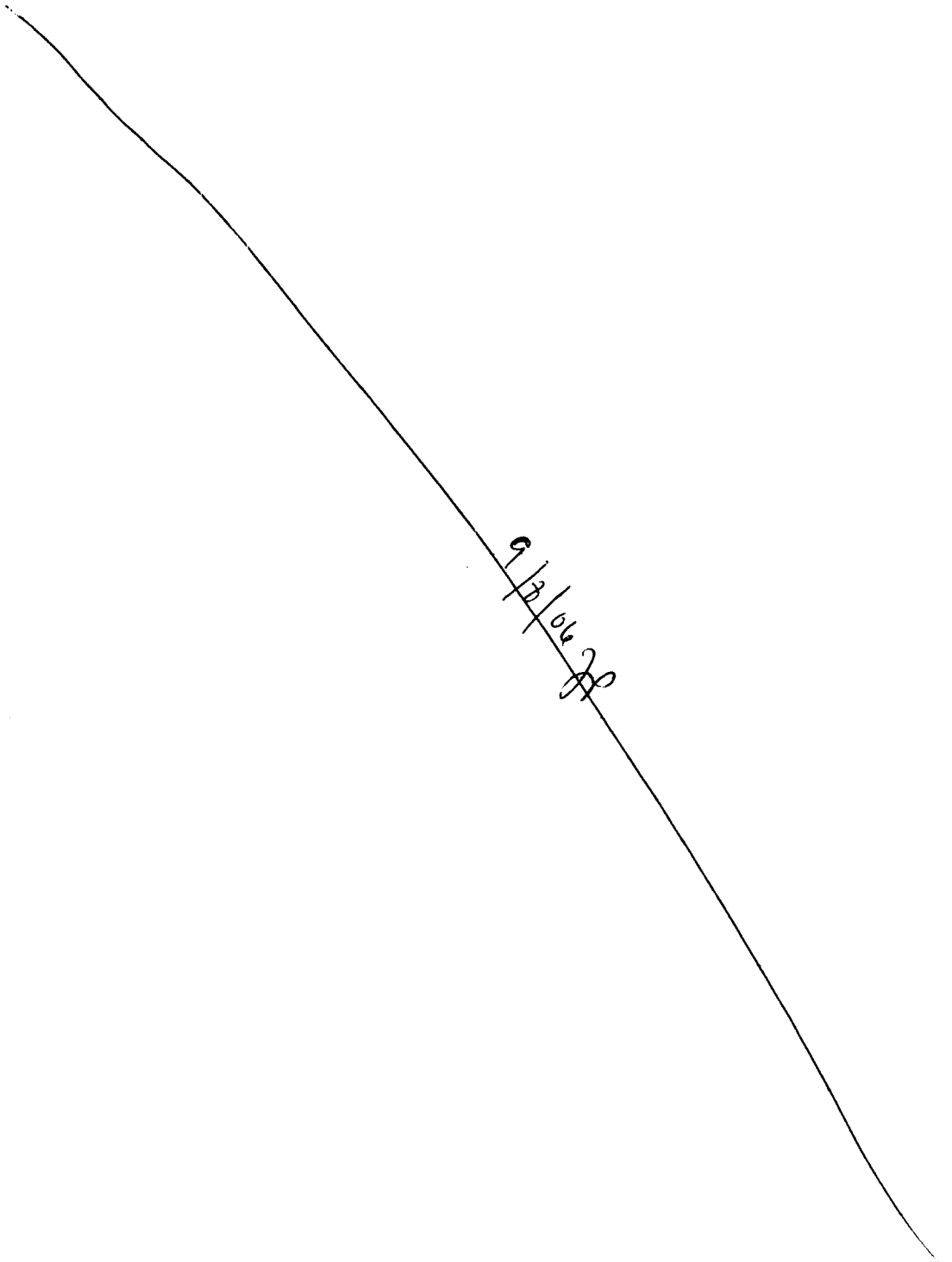
9/8/06 jp

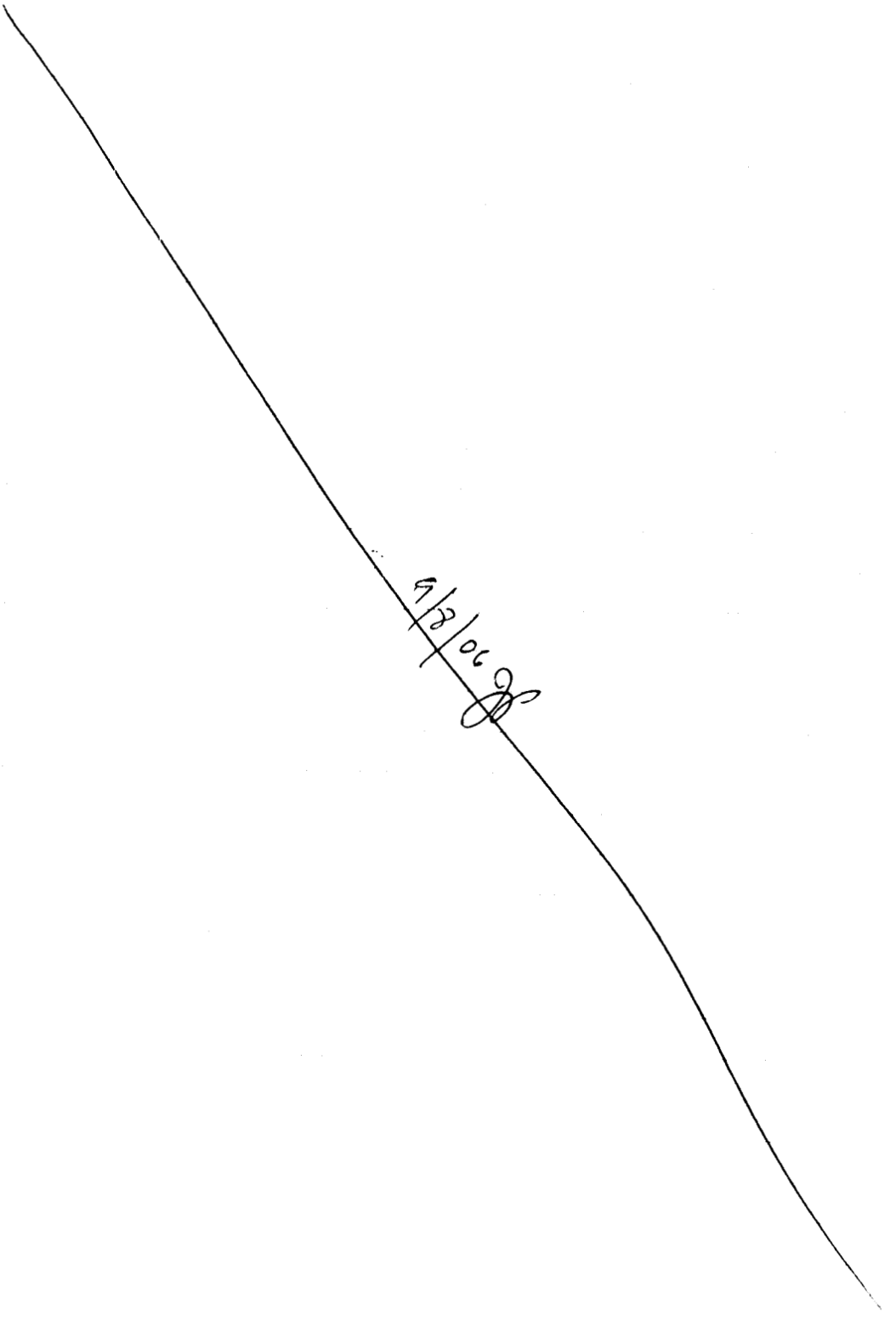
Radionuclide Release Rates and Solubility
20.06002.01.222

Initial entry 9/8/06 by James D. Ryan

This scientific notebook documents and chronicles laboratory studies being conducted for the Radionuclide Release Rates and Solubility Project.

jp 9/8/06


9/2/04


9/8/06

9/8/06 gp

Continuation of entries from scientific notebook 582.

Determination of an equilibrium constant (Log K) for example (see p 192-197; scientific notebook 582)

On pages 194-197 of scientific notebook 582, a summary of results for example dissolution experiment URSE and precipitation experiment UPEA are listed.

Examination of U, Ca, + Si results for experiments URSE and UPEA indicate a number of anomalous values (i.e., contents that do not follow overall trends in the data). For example, the measured U content of sample URSE-OA-5 (see p 194)(Notebook 582) is 0.13 ppm, which is twice as great as the U content in the previous sample URSE-OA-4 (0.056 ppm) and in the subsequent sample URSE-OA-6 (0.066 ppm). This suspected anomalous value is likely the cause of an analytical or sampling error.

A determination of sample equilibrium requires an analysis of mass transfer of sample components (U, Ca, Si) + pH (i.e.) moles of U, Ca, + Si released/precipitated versus time) Calculation of moles released depends on preceding analysis. Therefore, extremely more realistic values for samples with

9/8/06 JP
anomalous U, Si, + Ca contents for use in calculating moles released at subsequent times will improve the accuracy of the moles released data and help in the delineation of apparent equilibrium in the experimental solutions. This "massaging" of the data is considered valid and will improve the accuracy of the estimated equilibrium constant.

Summaries of the results of experiments URSE and UPEA in which anomalous U, Ca, + Si contents have been adjusted to better fit overall trends in the data are shown on the following pages.

9/8/06 JP

9/8/06 DP

Uranophane solubility experimental and estimated results (Experiment URSE)

Initial values

Label	U conc of matrix (m)	pH	U ppm	Corrected values Ca ppm	Si ppm
UME-0A	0	6.05	0.0000	386.00	33.412
UME-0B	0	6.05	0.0000	386.36	34.251
UME-7A	1.0x10-7	5.98	0.0230	388.23	34.131
UME-7B	1.0x10-7	5.98	0.0230	388.23	33.772

Experimental data and results.

Experiment label	Elapsed time (hrs)	pH of solution removed	Sample Label	Corrected and estimated values U ppm	Ca ppm	Si ppm	Values for EQ3 calcs UO2++	SiO2
	0.00							
URSE-0A	24.47	6.03	URSE-0A-1	0.0320	390.09	32.933	0.0363	70.451
	166.42	6.01	URSE-0A-2	0.0500	387.00	33.293	0.0567	71.219
	358.13	5.95	URSE-0A-3	0.0550	388.00	32.694	0.0624	69.938
	502.00	5.95	URSE-0A-4	0.0560	390.00	33.293	0.0635	71.219
	670.25	5.94	URSE-0A-5	0.0570	390.09	32.335	0.0647	69.170
	837.58	5.88	URSE-0A-6	0.0660	394.74	33.053	0.0748	70.707
	1007.72	5.90	URSE-0A-7	0.0610	395.67	32.694	0.0692	69.938
	1173.60	5.91	URSE-0A-8	0.0630	402.19	32.933	0.0714	70.451
	1342.02	5.90	URSE-0A-9	0.0440	404.98	33.053	0.0499	70.707
	1509.78	5.90	URSE-0A-10	0.0530	410.57	33.891	0.0601	72.500
	1677.83	5.92	URSE-0A-11	0.0550	412.00	33.891	0.0624	72.500
	0.00							
URSE-0B	24.50	6.04	URSE-0B-1	0.0300	392.00	33.412	0.0340	71.475
	166.42	6.06	URSE-0B-2	0.0340	390.09	33.000	0.0385	70.593
	358.15	5.97	URSE-0B-3	0.0480	389.16	32.400	0.0545	69.310
	502.02	5.95	URSE-0B-4	0.0480	396.61	32.600	0.0544	69.738
	670.27	5.97	URSE-0B-5	0.0500	396.61	32.694	0.0567	69.938
	837.60	5.89	URSE-0B-6	0.0550	397.54	33.532	0.0624	71.732
	1007.73	5.90	URSE-0B-7	0.0650	398.00	33.532	0.0737	71.732
	1173.62	5.91	URSE-0B-8	0.0500	400.33	33.652	0.0567	71.988
	1342.03	5.90	URSE-0B-9	0.0460	401.26	33.532	0.0522	71.732
	1509.80	5.89	URSE-0B-10	0.0480	404.05	33.891	0.0544	72.500
	1677.85	5.92	URSE-0B-11	0.0630	411.50	34.490	0.0714	73.781
	0.00							
URSE-7A	24.75	6.04	URSE-7A-1	0.0560	391.95	33.772	0.0635	72.244
	166.62	5.99	URSE-7A-2	0.0530	395.00	33.652	0.0601	71.988
	358.35	5.92	URSE-7A-3	0.0630	397.00	33.652	0.0714	71.988
	502.18	5.95	URSE-7A-4	0.0510	392.00	33.173	0.0578	70.963
	670.48	5.93	URSE-7A-5	0.0450	396.61	33.412	0.0510	71.475
	837.78	5.86	URSE-7A-6	0.0430	402.00	33.053	0.0488	70.707
	1007.97	5.86	URSE-7A-7	0.0440	401.26	33.652	0.0499	71.988
	1173.83	5.89	URSE-7A-8	0.0440	398.47	33.412	0.0499	71.475
	1342.25	5.87	URSE-7A-9	0.0450	403.12	32.933	0.0510	70.451
	1510.07	5.86	URSE-7A-10	0.0500	411.50	33.532	0.0567	71.732
	1678.15	5.88	URSE-7A-11	0.0490	412.43	34.131	0.0556	73.013
	0.00							
URSE-7B	24.77	6.02	URSE-7B-1	0.0510	390.09	33.891	0.0578	72.500
	166.62	5.98	URSE-7B-2	0.0550	391.00	33.173	0.0624	70.963
	358.37	5.91	URSE-7B-3	0.0610	391.95	33.053	0.0692	70.707
	502.20	5.93	URSE-7B-4	0.0730	392.88	33.173	0.0828	70.963
	670.50	5.93	URSE-7B-5	0.0740	395.00	32.933	0.0839	70.451
	837.80	5.84	URSE-7B-6	0.0600	400.33	33.412	0.0680	71.475
	1007.98	5.86	URSE-7B-7	0.0610	397.54	33.772	0.0692	72.244
	1173.85	5.92	URSE-7B-8	0.0660	402.19	34.251	0.0748	73.269
	1342.27	5.89	URSE-7B-9	0.0530	408.71	34.251	0.0601	73.269
	1510.08	5.88	URSE-7B-10	0.0620	405.92	34.370	0.0703	73.525
	1678.17	5.92	URSE-7B-11	0.0550	412.00	34.490	0.0624	73.781

[redacted]

7

4/8/06 gs

ppm
33.412
34.251
34.131
33.772

Log activity Ca++	SiO2	UO2++	H+	Q	logQ	log[(Ca2+)/(H+)^2]	log[(UO22+)/(H+)^2]
-2.2728	-2.9309	-8.6966	-6.03	44895209241	10.6522	9.7872	3.3634
-2.2755	-2.9262	-8.4671	-6.01	99517624317	10.9979	9.7445	3.5529
-2.2746	-2.9341	-8.3174	-5.95	83637299158	10.9224	9.6254	3.5826
-2.2729	-2.9262	-8.3099	-5.95	90136356708	10.9549	9.6271	3.5901
-2.2728	-2.9389	-8.2839	-5.94	83483375372	10.9216	9.6072	3.5961
-2.2688	-2.9293	-8.1155	-5.88	83483375372	10.9216	9.4912	3.6445
-2.268	-2.9341	-8.1842	-5.9	78595919652	10.8954	9.532	3.6158
-2.2625	-2.9309	-8.1884	-5.91	90970378148	10.9589	9.5575	3.6316
-2.2602	-2.9293	-8.3258	-5.9	42618680542	10.6296	9.5398	3.4742
-2.2556	-2.9185	-8.2455	-5.9	65523939402	10.8164	9.5444	3.5545
-2.2544	-2.9185	-8.2645	-5.92	79359696820	10.8996	9.5856	3.5755
-2.2711	-2.9247	-8.7433	-6.04	42943753373	10.6329	9.8089	3.3387
-2.2728	-2.9301	-8.7262	-6.06	59511377099	10.7746	9.8472	3.3938
-2.2736	-2.938	-8.4118	-5.97	70274861766	10.8468	9.6664	3.5282
-2.2672	-2.9353	-8.3769	-5.95	64327992726	10.8084	9.6328	3.5231
-2.2672	-2.9341	-8.3949	-5.97	78487410349	10.8948	9.6728	3.5451
-2.2664	-2.9231	-8.2114	-5.89	63767589443	10.8046	9.5136	3.5686
-2.266	-2.9231	-8.157	-5.9	94145594019	10.9738	9.534	3.643
-2.2641	-2.9215	-8.288	-5.91	59827382156	10.7769	9.5559	3.532
-2.2633	-2.9231	-8.3062	-5.9	47654070173	10.6781	9.5367	3.4938
-2.261	-2.9185	-8.2709	-5.89	50141809203	10.7002	9.519	3.5091
-2.2548	-2.9109	-8.2063	-5.92	1.07349E+11	11.0308	9.5852	3.6337
-2.2712	-2.92	-8.4732	-6.04	1.52195E+11	11.1824	9.8088	3.6068
-2.2686	-2.9216	-8.4058	-5.99	1.03896E+11	11.0166	9.7114	3.5742
-2.2669	-2.9215	-8.206	-5.92	99563464431	10.9981	9.5731	3.634
-2.2711	-2.9278	-8.3506	-5.95	74490347452	10.8721	9.6289	3.5494
-2.2672	-2.9247	-8.3692	-5.93	53088444423	10.725	9.5928	3.4908
-2.2627	-2.9293	-8.2657	-5.86	32158812236	10.5073	9.4573	3.4543
-2.2633	-2.9215	-8.256	-5.86	34809677523	10.5417	9.4567	3.464
-2.2656	-2.9247	-8.3081	-5.89	40625619819	10.6088	9.5144	3.4719
-2.2617	-2.9309	-8.264	-5.87	37025420540	10.5685	9.4783	3.476
-2.2548	-2.9231	-8.201	-5.86	45394161665	10.657	9.4652	3.519
-2.2541	-2.9154	-8.2442	-5.88	50897915925	10.7067	9.5059	3.5158
-2.2728	-2.9185	-8.4771	-6.02	1.13763E+11	11.056	9.7672	3.5629
-2.272	-2.9278	-8.3714	-5.98	1.02235E+11	11.0096	9.688	3.5886
-2.2712	-2.9293	-8.2017	-5.91	84488966948	10.9268	9.5488	3.6183
-2.2704	-2.9278	-8.1597	-5.93	1.36333E+11	11.1346	9.5896	3.7003
-2.2686	-2.9309	-8.154	-5.93	1.38548E+11	11.1416	9.5914	3.706
-2.2641	-2.9246	-8.0877	-5.84	56402713743	10.7513	9.4159	3.5923
-2.2664	-2.92	-8.1145	-5.86	66772863346	10.8246	9.4536	3.6055
-2.2625	-2.9139	-8.186	-5.92	1.14209E+11	11.0577	9.5775	3.654
-2.2571	-2.9139	-8.2279	-5.89	62994118055	10.7993	9.5229	3.5521
-2.2594	-2.9124	-8.1426	-5.88	81395425910	10.9106	9.5006	3.6174
-2.2544	-2.9109	-8.2645	-5.92	82186408039	10.9148	9.5856	3.5755

8

9/3/06 gp

Uranophane solubility experimental and estimated results (Experiment UPEA)

Initial values			Corrected values		
Label	U conc of matrix (m)	pH	U ppm	Ca ppm	Si ppm
UPM-1	1.0x10-6	6.02	0.2819	362.86	32.625
UPM-2	1.0x10-6	6.02	0.3083	361.77	32.300
UPM-3	2.0x10-6	5.99	0.5335	365.04	32.625
UPM-4	2.0x10-6	5.99	0.6126	361.77	32.300
UPM-5	1.0x10-6	5.95	0.2069	359.59	64.925
UPM-6	1.0x10-6	5.95	0.2251	348.70	63.191
UPM-7	2.0x10-6	6	0.4533	362.86	65.250
UMP-8	2.0x10-6	6	0.4899	365.04	65.359

Experimental data and results.

				Corrected or estimated values			Values for EQ3 calcs	
Experiment label	Sample Label	Elapsed time (hrs)	pH of solution	U ppm	Ca ppm	Si ppm	UO2++	SiO2
		0.00						
UPEA-1A	**UPEA-1A-1**	23.42	6.07	0.0271	361.77	31.709	0.0307	67.832
	UPEA-1A-2	47.30	6.04	0.0219	360.68	31.709	0.0249	67.832
	UPEA-1A-3	167.75	5.91	0.0294	361.77	31.064	0.0334	66.453
	UPEA-1A-4	335.60	5.92	0.0460	360.68	30.957	0.0522	66.223
	UPEA-1A-5	503.70	5.92	0.0635	363.95	31.279	0.0720	66.913
	UPEA-1A-6	679.23	5.96	0.0576	361.77	30.957	0.0654	66.223
	UPEA-1A-7	839.50	5.95	0.0535	362.86	30.527	0.0607	65.303
	UPEA-1A-8	1007.58	5.95	0.0611	365.04	31.064	0.0693	66.453
	UPEA-1A-9	1175.52	5.94	0.1105	365.04	30.957	0.1254	66.223
	UPEA-1A-10	1344.10	5.94	0.1034	368.31	31.279	0.1174	66.913
	UPEA-1A-11	1512.95	5.95	0.1034	369.40	30.742	0.1174	65.763
	UPEA-1A-12	1680.08	5.95	0.1065	370.49	31.279	0.1208	66.913
		0.00						
UPEA-1B	**UPEA-1B-1**	23.43	5.97	0.0504	361.80	32.371	0.0571	69.248
	UPEA-1B-2	47.27	5.97	0.0324	359.64	32.159	0.0367	68.793
	UPEA-1B-3	167.72	5.85	0.0480	362.88	32.052	0.0544	68.566
	UPEA-1B-4	335.55	5.84	0.0957	362.88	31.628	0.1086	67.658
	UPEA-1B-5	503.72	5.83	0.1028	363.96	31.734	0.1166	67.885
	UPEA-1B-6	679.20	5.84	0.0990	365.04	31.628	0.1123	67.658
	UPEA-1B-7	839.48	5.84	0.1249	365.04	31.522	0.1417	67.431
	UPEA-1B-8	1007.52	5.84	0.1249	366.12	31.522	0.1417	67.431
	UPEA-1B-9	1175.53	5.84	0.1365	366.12	31.522	0.1548	67.431
	UPEA-1B-10	1344.15	5.82	0.1414	367.99	31.482	0.1604	67.346
	UPEA-1B-11	1512.90	5.82	0.1515	367.99	31.991	0.1719	68.436
	UPEA-1B-12	1680.10	5.83	0.1414	370.01	31.788	0.1604	68.000
		0.00						
UPEA-2A	**UPEA-2A-1**	23.40	5.95	0.0277	359.64	64.848	0.0314	138.722
	UPEA-2A-2	47.25	5.90	0.0431	360.72	65.166	0.0489	139.403
	UPEA-2A-3	167.77	5.80	0.0545	361.80	64.848	0.0618	138.722
	UPEA-2A-4	335.57	5.79	0.0961	362.88	64.954	0.1090	138.949
	UPEA-2A-5	503.73	5.81	0.1134	361.80	64.742	0.1286	138.495
	UPEA-2A-6	679.18	5.81	0.1547	365.04	64.636	0.1755	138.268
	UPEA-2A-7	839.53	5.81	0.1538	368.28	65.485	0.1744	140.084
	UPEA-2A-8	1007.53	5.81	0.1269	368.28	65.272	0.1439	139.630
	UPEA-2A-9	1175.55	5.80	0.1547	369.36	65.591	0.1755	140.311
	UPEA-2A-10	1344.13	5.78	0.1616	370.01	64.798	0.1833	138.615
	UPEA-2A-11	1512.93	5.79	0.1616	372.03	64.899	0.1833	138.833
	UPEA-2A-12	1680.12	5.79	0.1919	372.03	65.409	0.2177	139.922
		0.00						
UPEA-2B	**UPEA-2B-1**	23.40	5.94	0.0511	358.50	62.989	0.0580	134.745
	UPEA-2B-2	47.25	5.89	0.0390	358.50	62.989	0.0443	134.745
	UPEA-2B-3	167.77	5.81	0.0676	359.59	62.666	0.0767	134.055
	UPEA-2B-4	335.57	5.79	0.1217	361.77	62.451	0.1381	133.595
	UPEA-2B-5	503.68	5.80	0.1095	365.04	62.881	0.1243	134.515
	UPEA-2B-6	679.22	5.81	0.1237	367.22	63.634	0.1404	136.125
	UPEA-2B-7	839.52	5.79	0.1007	367.22	63.526	0.1142	135.895
	UPEA-2B-8	1007.57	5.80	0.2039	368.31	63.419	0.2313	135.665
	UPEA-2B-9	1175.50	5.80	0.1927	367.22	63.419	0.2186	135.665
	UPEA-2B-10	1344.12	5.79	0.1623	368.31	63.634	0.1841	136.125
	UPEA-2B-11	1512.92	5.80	0.1684	368.31	62.881	0.1910	134.515
	UPEA-2B-12	1680.13	5.79	0.2069	370.49	63.849	0.2347	136.585

9/8/06 DF

ii ppm
32.625
32.300
32.625
32.300
64.925
63.191
65.250
65.359

Log activity Ca++	SiO2	UO2++	H+	Q	logQ	log[(Ca2+)/(H+)^2]	log[(UO22+)/(H+)^2]
-2.2983	-2.9474	-8.8423	-6.07	3.49E+10	10.5423	9.8417	3.2977
-2.2993	-2.9474	-8.8777	-6.04	1.95E+10	10.2905	9.7807	3.2023
-2.2983	-2.9563	-8.5162	-5.91	1.65E+10	10.2167	9.5217	3.3038
-2.2993	-2.9578	-8.3405	-5.92	4.21E+10	10.6241	9.5407	3.4995
-2.2962	-2.9533	-8.2016	-5.92	8.2E+10	10.914	9.5438	3.6384
-2.2983	-2.9578	-8.3145	-5.96	8.26E+10	10.9171	9.6217	3.6055
-2.2972	-2.9639	-8.3288	-5.95	6.57E+10	10.8174	9.6028	3.5712
-2.2952	-2.9563	-8.2716	-5.95	8.89E+10	10.949	9.6048	3.6284
-2.2952	-2.9578	-7.9982	-5.94	2.71E+11	11.4328	9.5848	3.8818
-2.2922	-2.9533	-8.0266	-5.94	2.44E+11	11.388	9.5878	3.8534
-2.2912	-2.9608	-8.0445	-5.95	2.5E+11	11.3982	9.6088	3.8555
-2.2902	-2.9533	-8.0323	-5.95	2.75E+11	11.4386	9.6098	3.8677
-2.2984	-2.9384	-8.3911	-5.97	7.29E+10	10.8626	9.6418	3.5489
-2.3003	-2.9413	-8.5823	-5.97	2.97E+10	10.4725	9.6397	3.3577
-2.2972	-2.9427	-8.2003	-5.85	3.29E+10	10.5168	9.4028	3.4997
-2.2972	-2.9485	-7.8845	-5.84	1.19E+11	11.0768	9.3828	3.7955
-2.2962	-2.947	-7.8368	-5.83	1.31E+11	11.1162	9.3638	3.8232
-2.2952	-2.9485	-7.8702	-5.84	1.28E+11	11.1074	9.3848	3.8098
-2.2952	-2.9499	-7.7701	-5.84	2.02E+11	11.3048	9.3848	3.9099
-2.2942	-2.9499	-7.7702	-5.84	2.02E+11	11.3056	9.3858	3.9098
-2.2942	-2.9499	-7.7322	-5.84	2.41E+11	11.3816	9.3858	3.9478
-2.2925	-2.9505	-7.6828	-5.82	2.3E+11	11.3609	9.3475	3.9572
-2.2925	-2.9435	-7.6531	-5.82	2.72E+11	11.4343	9.3475	3.9869
-2.2906	-2.9463	-7.6999	-5.83	2.49E+11	11.397	9.3694	3.9601
-2.3003	-2.6367	-8.614	-5.95	7.91E+10	10.8983	9.5997	3.286
-2.2993	-2.6345	-8.3335	-5.9	1.46E+11	11.1647	9.5007	3.4665
-2.2982	-2.6367	-8.0599	-5.8	1.28E+11	11.1086	9.3018	3.5401
-2.2972	-2.6359	-7.798	-5.79	3.76E+11	11.575	9.2828	3.782
-2.2982	-2.6374	-7.7605	-5.81	5.83E+11	11.766	9.3218	3.8595
-2.2952	-2.6381	-7.6271	-5.81	1.08E+12	12.0344	9.3248	3.9929
-2.2922	-2.6324	-7.6299	-5.81	1.1E+12	12.0432	9.3278	3.9901
-2.2922	-2.6338	-7.7124	-5.81	7.51E+11	11.8754	9.3278	3.9076
-2.2912	-2.6317	-7.6103	-5.8	1.06E+12	12.0248	9.3088	3.9897
-2.2906	-2.637	-7.5582	-5.78	9.98E+11	11.999	9.2694	4.0018
-2.2888	-2.6363	-7.575	-5.79	1.07E+12	12.0286	9.2912	4.005
-2.2888	-2.6329	-7.5015	-5.79	1.52E+12	12.1824	9.2912	4.0785
-2.3013	-2.6493	-8.3305	-5.94	2.39E+11	11.3791	9.5787	3.5495
-2.3013	-2.6493	-8.3586	-5.89	1.05E+11	11.0229	9.4787	3.4214
-2.3003	-2.6515	-7.9833	-5.81	1.95E+11	11.2901	9.3197	3.6367
-2.2983	-2.653	-7.6961	-5.79	5.54E+11	11.7435	9.2817	3.8839
-2.2952	-2.65	-7.7583	-5.8	4.88E+11	11.6882	9.3048	3.8417
-2.2932	-2.6449	-7.7229	-5.81	6.78E+11	11.8312	9.3268	3.8971
-2.2932	-2.6456	-7.7781	-5.79	3.98E+11	11.5994	9.2868	3.8019
-2.2922	-2.6463	-7.4923	-5.8	1.7E+12	12.2306	9.3078	4.1077
-2.2932	-2.6463	-7.5164	-5.8	1.52E+12	12.1814	9.3068	4.0836
-2.2922	-2.6449	-7.573	-5.79	1.03E+12	12.012	9.2878	4.007
-2.2922	-2.65	-7.5741	-5.8	1.15E+12	12.0596	9.3078	4.0259
-2.2902	-2.6434	-7.4694	-5.79	1.68E+12	12.2242	9.2898	4.1106

9/11/06 JP

Calculation of reaction quotients ($\log Q_s$) in the Uranophane dissolution precipitation tests.

The equilibrium reaction for uranophane can be written as

$$Ca(UO_2)_2(SiO_3OH)_2 \cdot 5H_2O + 6H^+ \Leftrightarrow Ca^{2+} + 2UO_2^{2+} + 2SiO_{2(aq)} + 9H_2O$$

The corresponding reaction quotient for uranophane is defined by

$$Q = [Ca^{2+}][UO_2^{2+}]^2[SiO_{2(aq)}]^2[H^+]^6$$

Where the square brackets represent thermodynamic activities. Using the pH and concentrations of Ca, Si, & U measured in experiments URSE (pH 6-7) and UPEA (pH 8-9) and assuming equilibrium with atmospheric PCO_2, activities of the aqueous species were determined using the EQ3NR geochemical code with the Data0.com.R2 database (Wolery 1992). Reaction quotients (Q_s) for the experimental solutions were calculated using the above equation.

The logarithms of activity for Ca^{2+}, $SiO_{2(aq)}$, UO_2^{2+} + H^+ and calculated logarithms of the reaction quotient ($\log Q$) for uranophane in the dissolution (URSE) + precipitation (UPEA)

9/11/00 JF
test solutions are shown on pages 6-9.

Mass transfer calculations

Thermodynamic interpretation of the unsaturated dissolution + precipitation test data requires knowledge of mass transfer (i.e., moles of Ca, Si, + U released or precipitated) as a function of time + solute chemistry.

Cumulative release in a dissolution or precipitation experiment is given by

$$n_{I,R}(t_s) = m_I(t_s)W(t_s) + n_{I,E}(t_s) - m_I(t_0)W(t_0)$$

where $n_{I,R}(t_s)$ is the net number of moles of a component I (e.g., Ca, Si, or U) released to solution at the time of sampling (t_s) (which is negative for net precipitation)

$m_I(t_s)$ is the molality of I in the solution at time t_s.

$m_I(t_0)$ is the molality of I in solution at the start of the experiment (t_0).

$W(t_s)$ is the mass of solvent prior to sampling at t_s.

$W(t_0)$ is the mass of solvent at time t_0.

and

9/11/06 gp

$n_{I,E}(t_s)$ is the number of moles of I extracted in all solution samples removed at all times t_p prior to time t_s, which is given by

$$n_{I,E}(t_s) = \sum m_I(t_p)\, W_E(t_p)$$

where

$m_I(t_p)$ is the molality of I in solution taken at time t_p and $W_E(t_p)$ is the mass of solution extracted in the sample taken at time t_p. Measurement of test solution masses before & after sampling provide values of W_0 & W_E, which allow effects in variation in solution mass due to sampling & evaporation to be explicitly accounted for in the cumulative mass transport calculations.

Results of the mass transport calculations for Ca, Si, & U in unsaturated test solutions URSE-0A, URSE-0B, URSE-7A, & URSE-7B & saturated test solutions UPEA-1A, UPEA-1B, UPEA-2A, & UPEA-2B are shown on the following pages.

Results also include the molar concentrations of U, Ca, & Si in the test solutions as a function of time.

9/11/06 JF URSE-0A - mass transfer calculation

Sample URSE-0A

Amount of uranophane added =	0.5009 g
Amount of 0.0 M U solution added =	200.25 g
Total sample wt =	229.32 g
Wt of bottle =	28.57 g

Concentrations of components in starting solutions	mg/L	molality	moles
U	0	0	0
Ca	386.00	0.009630739	0.001928555
Si	33.41	0.001189474	0.000238192

Sampling data	Elapsed time (hrs)	Wt of bottle before sampling (g)	Wt of soln before sampling (g)	Wt of bottle after sampling (g)	Wt of soln removed (g)	pH	U (ppm)	Ca (ppm)	Si (ppm)
	24.47	229.24	200.17	219.21	10.03	6.03	0.032	390.09	32.93
	166.42	217.81	188.74	207.80	10.01	6.01	0.050	387.00	33.29
	358.13	207.19	178.12	196.86	10.33	5.95	0.055	388.00	32.69
	502.00	196.40	167.33	186.32	10.08	5.95	0.056	390.00	33.29
	670.25	185.72	156.65	175.68	10.04	5.94	0.057	390.09	32.33
	837.58	175.16	146.09	164.97	10.19	5.88	0.066	394.74	33.05
	1007.72	164.33	135.26	154.57	9.76	5.90	0.061	395.67	32.69
	1173.60	153.92	124.85	143.97	9.95	5.91	0.063	402.19	32.93
	1342.02	143.36	114.29	133.50	9.86	5.90	0.044	404.98	33.05
	1509.78	132.68	103.61	122.68	10.00	5.90	0.053	410.57	33.89
	1677.83	121.80	92.73	111.86	9.94	5.92	0.055	412.00	33.89

Calculation of cumulative release (moles of U, Ca, Si released or precipitated as a function of time)

Defined by:

Cumulative moles released = (moles in soln at sampling time) + (moles extracted in all samples removed prior to sampling) - (initial moles in soln)

where

Moles in soln at sampling time = (measured molar concentration in sample) * (wt of soln before sampling) / 1000

Moles extracted during sampling = (measured molar concentration in sample) * (wt of soln removed during sampling) / 1000

	Elapsed time	Moles in soln at sampling time	Moles extracted during sampling	Moles extracted in all samples removed prior to sampling	Cumulative moles released
			0	0	
U	24.47	2.68947E-08	1.34763E-09	0	2.68947E-08
	166.42	3.96235E-08	2.10148E-09	1.34763E-09	4.09711E-08
	358.13	4.11333E-08	2.38552E-09	3.44911E-09	4.45824E-08
	502.00	3.93441E-08	2.37011E-09	5.83463E-09	4.51788E-08
	670.25	3.75121E-08	2.40423E-09	8.20474E-09	4.57168E-08
	837.58	4.04839E-08	2.82383E-09	1.0609E-08	5.10929E-08
	1007.72	3.46431E-08	2.49977E-09	1.34328E-08	4.80759E-08
	1173.60	3.30253E-08	2.63199E-09	1.59326E-08	4.89579E-08
	1342.02	2.11144E-08	1.82159E-09	1.85646E-08	3.96789E-08
	1509.78	2.30565E-08	2.22534E-09	2.03862E-08	4.34427E-08
	1677.83	2.14263E-08	2.29677E-09	2.26115E-08	4.40378E-08
			0	0	
Ca	24.47	0.001948196	9.76195E-05	0	1.96401E-05
	166.42	0.001822406	9.66534E-05	9.76195E-05	-8.5299E-06
	358.13	0.001724307	0.000100001	0.000194273	-9.9758E-06
	502.00	0.001628202	9.80838E-05	0.000294274	-6.0792E-06
	670.25	0.001524626	9.77168E-05	0.000392358	-1.1571E-05
	837.58	0.001438816	0.00010036	0.000490075	3.34805E-07
	1007.72	0.001335294	9.63519E-05	0.000590435	-2.8266E-06
	1173.60	0.001252826	9.98455E-05	0.000686787	1.10569E-05
	1342.02	0.001154823	9.96294E-05	0.000786632	1.29E-05
	1509.78	0.001061348	0.000102438	0.000886262	1.90545E-05
	1677.83	0.000953203	0.000102178	0.000988699	1.33472E-05
			0	0	
Si	24.47	0.000234682	1.17594E-05	0	-3.5098E-06
	166.42	0.000223696	1.1864E-05	1.17594E-05	-2.7372E-06
	358.13	0.000207312	1.2023E-05	2.36233E-05	-7.2571E-06
	502.00	0.00019832	1.19469E-05	3.56464E-05	-4.2256E-06
	670.25	0.000180319	1.15571E-05	4.75933E-05	-1.0279E-05
	837.58	0.000171901	1.19904E-05	5.91504E-05	-7.1411E-06
	1007.72	0.000157427	1.13596E-05	7.11408E-05	-9.6241E-06
	1173.60	0.000146376	1.16656E-05	8.25004E-05	-9.3161E-06
	1342.02	0.000134482	1.16021E-05	9.41659E-05	-9.544E-06
	1509.78	0.000125007	1.20653E-05	0.000105768	-7.4169E-06
	1677.83	0.00011188	1.19929E-05	0.000117833	-8.4786E-06

Molar concentration as a function of time	Elapsed time hours	U mol/L	Ca mol/L	Si mol/L
	0	0	0.009630739	0.001189474
	24.47	1.3436E-07	0.009732749	0.00117242
	166.42	2.09938E-07	0.009655589	0.00118521
	358.13	2.30931E-07	0.009680639	0.001163894
	502.00	2.3513E-07	0.009730539	0.00118521
	670.25	2.39466E-07	0.009732749	0.001151104
	837.58	2.77118E-07	0.009848891	0.001176684
	1007.72	2.56124E-07	0.00987212	0.001163894
	1173.60	2.64522E-07	0.010034719	0.00117242
	1342.02	1.84745E-07	0.010104405	0.001176684
	1509.78	2.22534E-07	0.010243776	0.001206527
	1677.83	2.31063E-07	0.010279441	0.001206527

14 9/11/06 gp URSE-0B Mass transfer calculations

Sample URSE-0B

Amount of uranophane added =	0.5006 g
Amount of 0.0 M U solution added =	200.06 g
Total sample wt =	229.17 g
Wt of bottle =	28.6 g

Concentrations of components in starting solutions	mg/L	molality	moles
U	0	0	0
Ca	386.36	0.009639835	0.001928545
Si	34.2506188	0.001219317	0.000243937

Sampling data

Elapsed time (hrs)	Wt of bottle before sampling (g)	Wt of soln before sampling (g)	Wt of bottle after sampling (g)	Wt of soln removed (g)	pH	U (ppm)	Ca (ppm)	Si (ppm)
24.50	229.08	199.98	218.79	10.29	6.04	0.030	392.00	33.41
166.42	218.32	189.22	208.28	10.04	6.06	0.034	390.09	33.00
358.15	207.63	178.53	197.30	10.33	5.97	0.048	389.16	32.40
502.02	196.84	167.74	186.80	10.04	5.95	0.048	396.61	32.60
670.27	186.20	157.10	176.17	10.03	5.97	0.050	396.61	32.69
837.60	175.54	146.44	165.55	9.99	5.89	0.055	397.54	33.53
1007.73	164.87	135.77	155.12	9.75	5.90	0.065	398.00	33.53
1173.62	154.38	125.28	144.44	9.94	5.91	0.050	400.33	33.65
1342.03	143.72	114.62	133.85	9.87	5.90	0.046	401.26	33.53
1509.80	133.03	103.93	123.10	9.93	5.89	0.048	404.05	33.89
1677.85	122.22	93.12	112.28	9.94	5.92	0.063	411.50	34.49

Calculation of cumulative release (moles of U, Ca, Si released or precipitated as a function of time)

Defined by:

Cumulative moles released = (moles in soln at sampling time) + (moles extracted in all samples removed prior to sampling) - (initial moles in soln)

where

Moles in soln at sampling time = (measured molar concentration in sample) * (wt of soln before sampling) / 1000

Moles extracted during sampling = (measured molar concentration in sample) * (wt of soln removed during sampling) / 1000

	Elapsed time	Moles in soln at sampling time	Moles extracted during sampling	Moles extracted in all samples removed prior to sampling	Cumulative moles released
			0	0	
U	24.50	2.51899E-08	1.29616E-09	0	2.51899E-08
	166.42	2.70125E-08	1.43329E-09	1.29616E-09	2.83087E-08
	358.15	3.60014E-08	2.0831E-09	2.72944E-09	3.87308E-08
	502.02	3.38062E-08	2.02346E-09	4.81254E-09	3.86188E-08
	670.27	3.29999E-08	2.10688E-09	6.836E-09	3.98359E-08
	837.60	3.38175E-08	2.30701E-09	8.94288E-09	4.27603E-08
	1007.73	3.70541E-08	2.66096E-09	1.12499E-08	4.83039E-08
	1173.62	2.63159E-08	2.08797E-09	1.39108E-08	4.02267E-08
	1342.03	2.21379E-08	1.90632E-09	1.59988E-08	3.81367E-08
	1509.80	2.0946E-08	2.00129E-09	1.79051E-08	3.88511E-08
	1677.85	2.46321E-08	2.62934E-09	1.99064E-08	4.45385E-08
			0	0	
Ca	24.50	0.001955886	0.000100641	0	2.7341E-05
	166.42	0.001841625	9.77168E-05	0.000100641	1.37203E-05
	358.15	0.001733435	0.000100299	0.000198358	3.24701E-06
	502.02	0.00165984	9.93493E-05	0.000298657	2.99513E-05
	670.27	0.001554553	9.92503E-05	0.000398006	2.40141E-05
	837.60	0.00145247	9.90866E-05	0.000497256	2.11816E-05
	1007.73	0.001348209	9.68189E-05	0.000596343	1.60069E-05
	1173.62	0.001251324	9.92833E-05	0.000693162	1.59401E-05
	1342.03	0.001147511	9.88134E-05	0.000792445	1.1411E-05
	1509.80	0.001047731	0.000100106	0.000891259	1.0444E-05
	1677.85	0.000956057	0.000102054	0.000991365	1.88768E-05
			0	0	
Si	24.50	0.00023787	1.22397E-05	0	-6.06635E-06
	166.42	0.000222294	1.17949E-05	1.22397E-05	-9.40284E-06
	358.15	0.000205922	1.1915E-05	2.40346E-05	-1.39798E-05
	502.02	0.000194671	1.1652E-05	3.59496E-05	-1.33161E-05
	670.27	0.000182847	1.16739E-05	4.76016E-05	-1.3488E-05
	837.60	0.00017481	1.19254E-05	5.92754E-05	-9.851E-06
	1007.73	0.000162073	1.16389E-05	7.12009E-05	-1.06627E-05
	1173.62	0.000150085	1.19081E-05	8.28398E-05	-1.1012E-05
	1342.03	0.000136825	1.17822E-05	9.47479E-05	-1.23632E-05
	1509.80	0.000125394	1.19808E-05	0.00010653	-1.20128E-05
	1677.85	0.000114336	1.22048E-05	0.000118511	-1.10896E-05

Molar concentration as a function of time	Elapsec time hours	U mol/L	Ca mol/L	Si mol/L
	0	0	0.009639835	0.001219317
	24.50	1.25963E-07	0.009780439	0.001189474
	166.42	1.42758E-07	0.009732749	0.001174795
	358.15	2.01655E-07	0.00970952	0.001153435
	502.02	2.0154E-07	0.009895348	0.001160555
	670.27	2.10058E-07	0.009895348	0.001163894
	837.60	2.30931E-07	0.009918577	0.001193737
	1007.73	2.72919E-07	0.00993014	0.001193737
	1173.62	2.10058E-07	0.009988262	0.001198
	1342.03	1.93143E-07	0.010011491	0.001193737
	1509.80	2.0154E-07	0.010081176	0.001206527
	1677.85	2.64522E-07	0.010267005	0.001227844

9/11/06 DF URSE-7A mass transfer calculations

Sample URSE-7A

Amount of uranophane added =	0.5004 g
Amount of 0.0 M U solution added	200.04 g
Total sample wt =	229.15 g
Wt of bottle =	28.62 g

Concentrations of components in starting solutions	mg/L	molality	moles
U	0.022986877	9.65713E-08	1.93181E-08
Ca	388.23	0.009686292	0.001937646
Si	34.13086134	0.001215054	0.000243059

Sampling data

Elapsed time (hrs)	Wt of bottle before sampling (g)	Wt of soln before sampling (g)	Wt of bottle after sampling (g)	Wt of soln removed (g)	pH	U (ppm)	Ca (ppm)	Si (ppm)
24.75	229.04	199.92	219.07	9.97	6.04	0.056	391.95	33.77
166.62	218.53	189.41	208.53	10.00	5.99	0.053	395.00	33.65
358.35	207.84	178.72	197.83	10.01	5.92	0.063	397.00	33.65
502.18	197.33	168.21	187.32	10.01	5.95	0.051	392.00	33.17
670.48	186.71	157.59	176.69	10.02	5.93	0.045	396.61	33.41
837.78	176.06	146.94	166.03	10.03	5.86	0.043	402.00	33.05
1007.97	165.33	136.21	155.57	9.76	5.86	0.044	401.26	33.65
1173.83	154.82	125.70	144.89	9.93	5.89	0.044	398.47	33.41
1342.25	144.26	115.14	134.39	9.87	5.87	0.045	403.12	32.93
1510.07	133.60	104.48	123.68	9.92	5.86	0.050	411.50	33.53
1678.15	122.88	93.76	112.90	9.98	5.88	0.049	412.43	34.13

Calculation of cumulative release (moles of U, Ca, Si released or precipitated as a function of time)

Defined by:

Cumulative moles released = (moles in soln at sampling time) + (moles extracted in all samples removed prior to sampling) - (initial moles in soln)

where

Moles in soln at sampling time = (measured molar concentration in sample) * (wt of soln before sampling) / 1000

Moles extracted during sampling = (measured molar concentration in sample) * (wt of soln removed during sampling) / 1000

	Elapsed time	Moles in soln at sampling time	Moles extracted during sampling	Moles extracted in all samples removed prior to sampling	Cumulative moles released
			0	0	
U	24.75	4.70071E-08	2.34425E-09	0	2.7689E-08
	166.62	4.21501E-08	2.22534E-09	2.34425E-09	2.51762E-08
	358.35	4.72752E-08	2.64786E-09	4.56959E-09	3.25266E-08
	502.18	3.60198E-08	2.14351E-09	7.21745E-09	2.39191E-08
	670.48	2.97756E-08	1.89322E-09	9.36095E-09	1.98184E-08
	837.78	2.65446E-08	1.81191E-09	1.12542E-08	1.84806E-08
	1007.97	2.51641E-08	1.80311E-09	1.30661E-08	1.8912E-08
	1173.83	2.32357E-08	1.83557E-09	1.48692E-08	1.87867E-08
	1342.25	2.17549E-08	1.86488E-09	1.67048E-08	1.91416E-08
	1510.07	2.19342E-08	2.08258E-09	1.85696E-08	2.11857E-08
	1678.15	1.9301E-08	2.05445E-09	2.06522E-08	2.06351E-08
			0	0	
Ca	24.75	0.001955055	9.74987E-05	0	1.74091E-05
	166.62	0.001866686	9.85529E-05	9.74987E-05	2.65393E-05
	358.35	0.001770252	9.91509E-05	0.000196052	2.86573E-05
	502.18	0.001645164	9.79022E-05	0.000295203	2.7205E-06
	670.48	0.001559404	9.91514E-05	0.000393105	1.48629E-05
	837.78	0.001473795	0.0001006	0.000492256	2.84057E-05
	1007.97	0.001363661	9.77122E-05	0.000592856	1.88718E-05
	1173.83	0.001249681	9.87221E-05	0.000690569	2.60373E-06
	1342.25	0.001158068	9.92719E-05	0.000789291	9.71301E-06
	1510.07	0.001072693	0.000101849	0.000888563	2.36094E-05
	1678.15	0.000964808	0.000102697	0.000990411	1.75737E-05
			0	0	
Si	24.75	0.000240356	1.19866E-05	0	-2.70327E-06
	166.62	0.000226913	1.198E-05	1.19866E-05	-4.16001E-06
	358.35	0.000214106	1.1992E-05	2.39666E-05	-4.98663E-06
	502.18	0.000198647	1.18213E-05	3.59586E-05	-8.45418E-06
	670.48	0.000187449	1.19185E-05	4.77798E-05	-7.83084E-06
	837.78	0.000172901	1.18021E-05	5.96984E-05	-1.04596E-05
	1007.97	0.000163179	1.16925E-05	7.15005E-05	-8.3797E-06
	1173.83	0.000149516	1.18115E-05	8.3193E-05	-1.035E-05
	1342.25	0.000134992	1.15718E-05	9.50045E-05	-1.30629E-05
	1510.07	0.000124721	1.18419E-05	0.000106576	-1.17619E-05
	1678.15	0.000113923	1.21262E-05	0.000118418	-1.07183E-05

Molar concentration as a function of time	Elapsed time hours	U mol/L	Ca mol/L	Si mol/L
	0	9.65713E-08	0.009686292	0.001215054
	24.75	2.3513E-07	0.009779206	0.001202264
	166.62	2.22534E-07	0.009855289	0.001198
	358.35	2.64522E-07	0.00990519	0.001198
	502.18	2.14136E-07	0.009780439	0.001180947
	670.48	1.88944E-07	0.009895348	0.001189474
	837.78	1.80649E-07	0.01002994	0.001176684
	1007.97	1.84745E-07	0.010011491	0.001198
	1173.83	1.84851E-07	0.009941805	0.001189474
	1342.25	1.88944E-07	0.010057948	0.00117242
	1510.07	2.09938E-07	0.010267005	0.001193737
	1678.15	2.05856E-07	0.010290233	0.001215054

9/11/06 pp URSE-7B Mass transfer calculation

Sample URSE-7B

Amount of uranophane	0.5008 g
Amount of 0.0 M U s	200.02 g
Total sample wt =	229.11 g
Wt of bottle =	28.58 g

Concentrations of components in starting solutions

	mg/L	molality	moles
U	0.022986877	9.65713E-08	1.93162E-08
Ca	388.23	0.009686292	0.001937452
Si	33.77158912	0.001202264	0.000240477

Sampling data

Elapsed time (hrs)	Wt of bottle before sampling (g)	Wt of soln before sampling (g)	Wt of bottle after sampling (g)	Wt of soln removed (g)	pH	U (ppm)	Ca (ppm)	Si (ppm)
24.77	229.02	199.94	219.05	9.97	6.02	0.051	390.09	33.89
166.62	218.42	189.34	208.12	10.30	5.98	0.055	391.00	33.17
358.37	207.47	178.39	197.47	10.00	5.91	0.061	391.95	33.05
502.20	196.96	167.88	186.95	10.01	5.93	0.073	392.88	33.17
670.50	186.38	157.30	176.37	10.01	5.93	0.074	395.00	32.93
837.80	175.75	146.67	165.74	10.01	5.84	0.060	400.33	33.41
1007.98	165.02	135.94	155.26	9.76	5.86	0.061	397.54	33.77
1173.85	154.50	125.42	144.61	9.89	5.92	0.066	402.19	34.25
1342.27	144.01	114.93	134.15	9.86	5.89	0.053	408.71	34.25
1510.08	133.03	103.95	123.12	9.91	5.88	0.062	405.92	34.37
1678.17	122.41	93.33	112.45	9.96	5.92	0.055	412.00	34.49

Calculation of cumulative release (moles of U, Ca, Si released or precipitated as a function of time)

Defined by:

Cumulative moles released = (moles in soln at sampling time) + (moles extracted in all samples removed prior to sampling) - (initial moles in soln)

where

Moles in soln at sampling time = (measured molar concentration in sample) * (wt of soln before sampling) / 1000

Moles extracted during sampling = (measured molar concentration in sample) * (wt of soln removed during sampling) / 1000

	Elapsed time	Moles in soln at sampling time	Moles extracted during sampling	Moles extracted in all samples removed prior to sampling	Cumulative moles released
			0	0	
U	24.77	4.28143E-08	2.13494E-09	0	2.3498E-08
	166.62	4.37493E-08	2.37995E-09	2.13494E-09	2.6568E-08
	358.37	4.56898E-08	2.56124E-09	4.51489E-09	3.0888E-08
	502.20	5.14565E-08	3.06816E-09	7.07613E-09	3.9216E-08
	670.50	4.88741E-08	3.11019E-09	1.01443E-08	3.9702E-08
	837.80	3.69497E-08	2.52177E-09	1.32545E-08	3.0888E-08
	1007.98	3.48372E-08	2.5012E-09	1.57762E-08	3.1297E-08
	1173.85	3.47559E-08	2.74069E-09	1.82774E-08	3.3717E-08
	1342.27	2.55757E-08	2.19418E-09	2.10181E-08	2.7278E-08
	1510.08	2.70603E-08	2.5798E-09	2.32123E-08	3.0956E-08
	1678.17	2.1565E-08	2.30139E-09	2.57921E-08	2.8041E-08
			0	0	
Ca	24.77	0.001945958	9.70355E-05	0	8.5059E-06
	166.62	0.001847096	0.000100482	9.70355E-05	6.6799E-06
	358.37	0.001744505	9.77921E-05	0.000197517	4.5697E-06
	502.20	0.001645625	9.81224E-05	0.000295309	3.4819E-06
	670.50	0.001550229	9.86514E-05	0.000393431	6.2086E-06
	837.80	0.00146497	9.99825E-05	0.000492083	1.9601E-05
	1007.98	0.001348323	9.68053E-05	0.000592065	2.9368E-06
	1173.85	0.001258546	9.92434E-05	0.000688871	9.9652E-06
	1342.27	0.00117197	0.000100546	0.000788114	2.2632E-05
	1510.08	0.001052759	0.000100365	0.00088866	3.967E-06
	1678.17	0.000959372	0.000102383	0.000989025	1.0944E-05
			0	0	
Si	24.77	0.000241232	1.20291E-05	0	7.5527E-07
	166.62	0.0002236	1.21638E-05	1.20291E-05	-4.8482E-06
	358.37	0.000209908	1.17668E-05	2.41928E-05	-6.3763E-06
	502.20	0.000198256	1.18213E-05	3.59597E-05	-6.2607E-06
	670.50	0.000184421	1.17359E-05	4.77809E-05	-8.2751E-06
	837.80	0.000174459	1.19066E-05	5.95169E-05	-6.5008E-06
	1007.98	0.000163435	1.17341E-05	7.14235E-05	-5.6185E-06
	1173.85	0.000152926	1.2059E-05	8.31576E-05	-4.3934E-06
	1342.27	0.000140135	1.20225E-05	9.52166E-05	-5.125E-06
	1510.08	0.00012719	1.21257E-05	0.000107239	-6.0475E-06
	1678.17	0.000114594	1.22293E-05	0.000119365	-6.5183E-06

Molar concentration of time	Elapsed time hours	U mol/L	Ca mol/L	Si mol/L
	0	9.65713E-08	0.009686292	0.001202264
	24.77	2.14736E-07	0.009732749	0.001206527
	166.62	2.31063E-07	0.009755489	0.001180947
	358.37	2.56724E-07	0.009779206	0.001176684
	502.20	3.06509E-07	0.009802434	0.001180947
	670.50	3.10708E-07	0.009855289	0.00117242
	837.80	2.51925E-07	0.009988262	0.001189474
	1007.98	2.5627E-07	0.009918577	0.001202264
	1173.85	2.77118E-07	0.010034719	0.001219317
	1342.27	2.22534E-07	0.010197319	0.001219317
	1510.08	2.60023E-07	0.010127833	0.00122358
	1678.17	2.31063E-07	0.010279441	0.001227844

Sample UPEA-1A

Amount of uranophane added =	0.5002 g
Amount of matrix solution added =	200.16 g
Total sample wt =	229.21 g
Wt of bottle =	28.54 g

Concentrations of components in starting solutions	mg/L	molality	moles
U	0.29512781	1.23988E-06	2.48174E-07
Ca	362.32	0.009039835	0.001809413
Si	32.46	0.00115566	0.000231317

Sampling data

Elapsed time (hrs)	Wt of bottle before sampling (g)	Wt of soln before sampling (g)	Wt of bottle after sampling (g)	Wt of soln removed (g)	pH	U (ppm)	Ca (ppm)	Si (ppm)
23.42	229.13	200.09	218.17	10.96	6.07	0.027	361.77	31.71
47.30	218.10	189.06	207.38	10.72	6.04	0.022	360.68	31.71
167.75	207.06	178.02	196.80	10.26	5.91	0.029	361.77	31.06
335.60	196.42	167.38	186.43	9.99	5.92	0.046	360.68	30.96
503.70	186.07	157.03	176.03	10.04	5.92	0.063	363.95	31.28
679.23	175.63	146.59	165.65	9.98	5.96	0.058	361.77	30.96
839.50	165.05	136.01	155.05	10.00	5.95	0.054	362.86	30.53
1007.58	154.84	125.80	144.91	9.93	5.95	0.061	365.04	31.06
1175.52	144.78	115.74	134.83	9.95	5.94	0.111	365.04	30.96
1344.10	134.56	105.52	124.58	9.98	5.94	0.103	368.31	31.28
1512.95	124.31	95.27	114.35	9.96	5.95	0.103	369.40	30.74
1680.08	114.11	85.07	104.10	10.01	5.95	0.106	370.49	31.28

Calculation of cumulative release (moles of U, Ca, Si released or precipitated as a function of time)

Defined by:

Cumulative moles released = (moles in soln at sampling time) + (moles extracted in all samples removed prior to sampling) - (initial moles in soln)

where

Moles in soln at sampling time = (measured molar concentration in sample) * (wt of soln before sampling) / 1000

Moles extracted during sampling = (measured molar concentration in sample) * (wt of soln removed during sampling) / 1000

	Elapsed time	Moles in soln at sampling time	Moles extracted during sampling	Moles extracted in all samples removed prior to sampling	Cumulative moles released
			0	0	
U	23.42	2.27626E-08	1.24683E-09	0	-2.25411E-07
	47.30	1.73996E-08	9.86584E-10	1.24683E-09	-2.29527E-07
	167.75	2.19964E-08	1.26774E-09	2.23341E-09	-2.23944E-07
	335.60	3.23776E-08	1.93244E-09	3.50116E-09	-2.12295E-07
	503.70	4.18834E-08	2.67789E-09	5.4336E-09	-2.00857E-07
	679.23	3.54762E-08	2.41526E-09	8.11149E-09	-2.04586E-07
	839.50	3.05978E-08	2.24967E-09	1.05268E-08	-2.07049E-07
	1007.58	3.22672E-08	2.54701E-09	1.27764E-08	-2.0313E-07
	1175.52	5.3752E-08	4.62099E-09	1.53234E-08	-1.79098E-07
	1344.10	4.58585E-08	4.33727E-09	1.99444E-08	-1.82371E-07
	1512.95	4.14039E-08	4.32858E-09	2.42817E-08	-1.82488E-07
	1680.08	3.80584E-08	4.47826E-09	2.86103E-08	-1.81505E-07
			0	0	
Ca	23.42	0.001806059	9.89276E-05	0	-3.35456E-06
	47.30	0.001701359	9.64699E-05	9.89276E-05	-9.12646E-06
	167.75	0.00160685	9.26092E-05	0.000195397	-7.16625E-06
	335.60	0.00150626	8.99005E-05	0.000288007	-1.51469E-05
	503.70	0.001425927	9.11694E-05	0.000377907	-5.57878E-06
	679.23	0.001323155	9.00819E-05	0.000469077	-1.71818E-05
	839.50	0.001231355	9.05343E-05	0.000559159	-1.88998E-05
	1007.58	0.00114576	9.04405E-05	0.000649693	-1.39607E-05
	1175.52	0.001054135	9.06226E-05	0.000740133	-1.51447E-05
	1344.10	0.00096966	9.17099E-05	0.000830756	-8.99736E-06
	1512.95	0.000878059	9.17969E-05	0.000922466	-8.88834E-06
	1680.08	0.000786363	9.25298E-05	0.001014263	-8.78748E-06
			0	0	
Si	23.42	0.000225871	1.23722E-05	0	-5.44597E-06
	47.30	0.00021342	1.21012E-05	1.23722E-05	-5.52499E-06
	167.75	0.00019687	1.13464E-05	2.44734E-05	-9.97348E-06
	335.60	0.000184463	1.10096E-05	3.58198E-05	-1.10342E-05
	503.70	0.000174859	1.118E-05	4.68294E-05	-9.62829E-06
	679.23	0.000161551	1.09986E-05	5.80094E-05	-1.17565E-05
	839.50	0.000147809	1.08675E-05	6.90079E-05	-1.44996E-05
	1007.58	0.00013912	1.09815E-05	7.98755E-05	-1.23209E-05
	1175.52	0.000127552	1.09655E-05	9.0857E-05	-1.29075E-05
	1344.10	0.000117501	1.11131E-05	0.000101822	-1.19937E-05
	1512.95	0.000104264	1.09003E-05	0.000112936	-1.41172E-05
	1680.08	9.47287E-05	1.11465E-05	0.000123836	-1.27522E-05

Molar concentration as a function of time	Elapsed time hours	U mol/L	Ca mol/L	Si mol/L
	0	1.23988E-06	0.009039835	0.00115566
	23.42	1.13762E-07	0.009026241	0.001128847
	47.30	9.20321E-08	0.008999054	0.001128847
	167.75	1.23562E-07	0.009026241	0.001105888
	335.60	1.93438E-07	0.008999054	0.001102061
	503.70	2.66723E-07	0.009080616	0.001113541
	679.23	2.4201E-07	0.009026241	0.001102061
	839.50	2.24967E-07	0.009053428	0.001086755
	1007.58	2.56497E-07	0.009107803	0.001105888
	1175.52	4.64421E-07	0.009107803	0.001102061
	1344.10	4.34596E-07	0.009189366	0.001113541
	1512.95	4.34596E-07	0.009216553	0.001094408
	1680.08	4.47378E-07	0.009243741	0.001113541

9/11/06 JP UPEA-1B Mass transfer calculation

Sample UPEA-1B

Amount of uranophane added =	0.5004 g
Amount of 0.0 M U solution added =	200.16 g
Total sample wt =	229.27 g
Wt of bottle =	28.59 g

Concentrations of components in starting solutions

	mg/L	molality	moles
U	0.573014484	2.40732E-06	4.81849E-07
Ca	363.41	0.009067022	0.001814855
Si	32.46247935	0.00115566	0.000231317

Sampling data

Elapsed time (hrs)	Wt of bottle before sampling (g)	Wt of soln before sampling (g)	Wt of bottle after sampling (g)	Wt of soln removed (g)	pH	U (ppm)	Ca (ppm)	Si (ppm)
23.43	229.19	200.10	218.20	10.99	5.97	0.050	361.80	32.37
47.27	218.14	189.05	207.43	10.71	5.97	0.032	359.64	32.16
167.72	207.14	178.05	197.09	10.05	5.85	0.048	362.88	32.05
335.55	196.68	167.59	186.66	10.02	5.84	0.096	362.88	31.63
503.72	186.27	157.18	176.23	10.04	5.83	0.103	363.96	31.73
679.20	175.79	146.70	165.79	10.00	5.84	0.099	365.04	31.63
839.48	165.27	136.18	155.23	10.04	5.84	0.125	365.04	31.52
1007.52	155.06	125.97	145.12	9.94	5.84	0.125	366.12	31.52
1175.53	144.97	115.88	135.05	9.92	5.84	0.136	366.12	31.52
1344.15	134.81	105.72	124.57	10.24	5.82	0.141	367.99	31.48
1512.90	124.39	95.30	114.43	9.96	5.82	0.151	367.99	31.99
1680.10	114.19	85.10	104.24	9.95	5.83	0.141	370.01	31.79

Calculation of cumulative release (moles of U, Ca, Si released or precipitated as a function of time)

Defined by:

Cumulative moles released = (moles in soln at sampling time) + (moles extracted in all samples removed prior to sampling) - (initial moles in soln)

where

Moles in soln at sampling time = (measured molar concentration in sample) * (wt of soln before sampling) / 1000

Moles extracted during sampling = (measured molar concentration in sample) * (wt of soln removed during sampling) / 1000

	Elapsed time	Moles in soln at sampling time	Moles extracted during sampling	Moles extracted in all samples removed prior to sampling	Cumulative moles released
			0	0	
U	23.43	4.23316E-08	2.32497E-09	0	-4.39518E-07
	47.27	2.57213E-08	1.45716E-09	2.32497E-09	-4.53803E-07
	167.72	3.58698E-08	2.02467E-09	3.78213E-09	-4.42197E-07
	335.55	6.73898E-08	4.02916E-09	5.8068E-09	-4.08653E-07
	503.72	6.78997E-08	4.33716E-09	9.83596E-09	-4.04114E-07
	679.20	6.10034E-08	4.15839E-09	1.41731E-08	-4.06673E-07
	839.48	7.14732E-08	5.26944E-09	1.83315E-08	-3.92045E-07
	1007.52	6.61145E-08	5.21696E-09	2.36009E-08	-3.92134E-07
	1175.53	6.64329E-08	5.68706E-09	2.88179E-08	-3.86598E-07
	1344.15	6.2799E-08	6.08271E-09	3.4505E-08	-3.84545E-07
	1512.90	6.06529E-08	6.33898E-09	4.05877E-08	-3.80609E-07
	1680.10	5.05504E-08	5.91044E-09	4.69267E-08	-3.84372E-07
			0	0	
Ca	23.43	0.001806288	9.92061E-05	0	-8.56686E-06
	47.27	0.001696352	9.61014E-05	9.92061E-05	-1.92968E-05
	167.72	0.001612042	9.09916E-05	0.000195308	-7.50573E-06
	335.55	0.001517338	9.072E-05	0.000286299	-1.12178E-05
	503.72	0.001427323	9.11716E-05	0.000377019	-1.05135E-05
	679.20	0.001336108	9.10778E-05	0.000468191	-1.05561E-05
	839.48	0.001240294	9.14422E-05	0.000559269	-1.52921E-05
	1007.52	0.001150698	9.07992E-05	0.000650711	-1.3446E-05
	1175.53	0.001058529	9.06165E-05	0.00074151	-1.48162E-05
	1344.15	0.000970648	9.4017E-05	0.000832127	-1.20804E-05
	1512.90	0.000874979	9.14462E-05	0.000926144	-1.37331E-05
	1680.10	0.000785622	9.18563E-05	0.00101759	-1.16436E-05
			0	0	
Si	23.43	0.000230594	1.26648E-05	0	-7.22591E-07
	47.27	0.000216432	1.22612E-05	1.26648E-05	-2.22033E-06
	167.72	0.000203166	1.14677E-05	2.49261E-05	-3.22506E-06
	335.55	0.000188697	1.1282E-05	3.63938E-05	-6.22575E-06
	503.72	0.00017757	1.13425E-05	4.76758E-05	-6.07099E-06
	679.20	0.000165176	1.12595E-05	5.90182E-05	-7.12235E-06
	839.48	0.000152817	1.12666E-05	7.02777E-05	-8.22238E-06
	1007.52	0.000141359	1.11544E-05	8.15443E-05	-8.41315E-06
	1175.53	0.000130037	1.11319E-05	9.26987E-05	-8.58148E-06
	1344.15	0.000118485	1.14765E-05	0.000103831	-9.001E-06
	1512.90	0.000108535	1.13433E-05	0.000115307	-7.47447E-06
	1680.10	9.63013E-05	1.12597E-05	0.00012665	-8.36512E-06

Molar concentration as a function of time

Elapsed time hours	U mol/L	Ca mol/L	Si mol/L
0	2.40732E-06	0.009067022	0.00115566
23.43	2.11553E-07	0.009026946	0.001152397
47.27	1.36056E-07	0.008973054	0.001144841
167.72	2.0146E-07	0.009053892	0.001141062
335.55	4.02112E-07	0.009053892	0.001125949
503.72	4.31988E-07	0.009080838	0.001129727
679.20	4.15839E-07	0.009107784	0.001125949
839.48	5.24845E-07	0.009107784	0.001122171
1007.52	5.24845E-07	0.009134731	0.001122171
1175.53	5.73292E-07	0.009134731	0.001122171
1344.15	5.94015E-07	0.009161346	0.00112075
1512.90	6.36444E-07	0.009161346	0.001138885
1680.10	5.94015E-07	0.009231793	0.001131631

9/11/06 gp UPEA-2A Mass transfer calculations

Sample UPEA-2A

Amount of uranophane added =	0.5001 g
Amount of 0.0 M U solution added =	200.07 g
Total sample wt =	229.09 g
Wt of bottle =	28.53 g

Concentrations of components in starting solutions	mg/L	molality	moles
U	0.21602139	9.07539E-07	1.81571E-07
Ca	363.95	0.009080616	0.001816759
Si	65.30431989	0.002324824	0.000465128

Sampling data

Elapsed time (hrs)	Wt of bottle before sampling (g)	Wt of soln before sampling (g)	Wt of bottle after sampling (g)	Wt of soln removed (g)	pH	U (ppm)	Ca (ppm)	Si (ppm)
23.40	229.00	199.97	218.55	10.45	5.95	0.028	359.64	64.85
47.25	218.48	189.45	207.75	10.73	5.90	0.043	360.72	65.17
167.77	207.44	178.41	197.17	10.27	5.80	0.054	361.80	64.85
335.57	196.73	167.70	186.75	9.98	5.79	0.096	362.88	64.95
503.73	186.36	157.33	176.06	10.30	5.81	0.113	361.80	64.74
679.18	175.59	146.56	165.67	9.92	5.81	0.155	365.04	64.64
839.53	165.04	136.01	155.05	9.99	5.81	0.154	368.28	65.48
1007.53	154.86	125.83	145.07	9.79	5.81	0.127	368.28	65.27
1175.55	144.87	115.84	134.84	10.03	5.80	0.155	369.36	65.59
1344.13	134.48	105.45	124.23	10.25	5.78	0.162	370.01	64.80
1512.93	123.90	94.87	113.95	9.95	5.79	0.162	372.03	64.90
1680.12	113.68	84.65	103.73	9.95	5.79	0.192	372.03	65.41

Calculation of cumulative release (moles of U, Ca, Si released or precipitated as a function of time)

Defined by:

Cumulative moles released = (moles in soln at sampling time) + (moles extracted in all samples removed prior to sampling) - (initial moles in soln)

where

Moles in soln at sampling time = (measured molar concentration in sample) * (wt of soln before sampling) / 1000

Moles extracted during sampling = (measured molar concentration in sample) * (wt of soln removed during sampling) / 1000

	Elapsed time	Moles in soln at sampling time	Moles extracted during sampling	Moles extracted in all samples removed prior to sampling	Cumulative moles released
			0	0	
U	23.40	2.32512E-08	1.21506E-09	0	-1.5832E-07
	47.25	3.43422E-08	1.94506E-09	1.21506E-09	-1.46014E-07
	167.77	4.08404E-08	2.35094E-09	3.16012E-09	-1.37571E-07
	335.57	6.7705E-08	4.02919E-09	5.51106E-09	-1.08355E-07
	503.73	7.49516E-08	4.9069E-09	9.54025E-09	-9.70794E-08
	679.18	9.5264E-08	6.448E-09	1.44471E-08	-7.18601E-08
	839.53	8.78574E-08	6.45317E-09	2.08951E-08	-7.28187E-08
	1007.53	6.70572E-08	5.21728E-09	2.73483E-08	-8.71657E-08
	1175.55	7.5296E-08	6.5195E-09	3.25656E-08	-7.37097E-08
	1344.13	7.15872E-08	6.95846E-09	3.90851E-08	-7.0899E-08
	1512.93	6.44047E-08	6.75479E-09	4.60436E-08	-7.1123E-08
	1680.12	6.82416E-08	8.02132E-09	5.27984E-08	-6.05313E-08
			0	0	
Ca	23.40	0.001794341	9.37684E-05	0	-2.24181E-05
	47.25	0.001705049	9.657E-05	9.37684E-05	-1.79413E-05
	167.77	0.001610497	9.27067E-05	0.000190338	-1.59239E-05
	335.57	0.001518337	9.03578E-05	0.000283045	-1.53769E-05
	503.73	0.001420209	9.29775E-05	0.000373403	-2.31473E-05
	679.18	0.001334836	9.03492E-05	0.000466381	-1.55423E-05
	839.53	0.001249744	9.17943E-05	0.00055673	-1.02854E-05
	1007.53	0.001156203	8.99566E-05	0.000648524	-1.20312E-05
	1175.55	0.001067531	9.24322E-05	0.000738481	-1.07475E-05
	1344.13	0.000973492	9.46259E-05	0.000830913	-1.23543E-05
	1512.93	0.000880605	9.23583E-05	0.000925539	-1.06149E-05
	1680.12	0.000785741	9.23583E-05	0.001017897	-1.31211E-05
			0	0	
Si	23.40	0.000461645	2.41246E-05	0	-3.48252E-06
	47.25	0.000439506	2.48926E-05	2.41246E-05	-1.4967E-06
	167.77	0.000411872	2.3709E-05	4.90172E-05	-4.23816E-06
	335.57	0.000387781	2.30773E-05	7.27262E-05	-4.6203E-06
	503.73	0.000362613	2.37394E-05	9.58035E-05	-6.71101E-06
	679.18	0.000337237	2.28261E-05	0.000119543	-8.34802E-06
	839.53	0.000317072	2.32891E-05	0.000142369	-5.68652E-06
	1007.53	0.000292389	2.27489E-05	0.000165658	-7.08031E-06
	1175.55	0.000270489	2.34203E-05	0.000188407	-6.232E-06
	1344.13	0.00024325	2.36446E-05	0.000211827	-1.005E-05
	1512.93	0.000219189	2.29886E-05	0.000235472	-1.04672E-05
	1680.12	0.000197111	2.31691E-05	0.00025846	-9.55587E-06

Molar concentration as a function of time	Elapsed time hours	U mol/L	Ca mol/L	Si mol/L
	0	9.07539E-07	0.009080616	0.002324824
	23.40	1.16273E-07	0.008973054	0.002308573
	47.25	1.81273E-07	0.009	0.002319908
	167.77	2.28913E-07	0.009026946	0.002308573
	335.57	4.03727E-07	0.009053892	0.002312351
	503.73	4.76398E-07	0.009026946	0.002304795
	679.18	6.5E-07	0.009107784	0.002301016
	839.53	6.45963E-07	0.009188623	0.002331243
	1007.53	5.32919E-07	0.009188623	0.002323686
	1175.55	6.5E-07	0.009215569	0.002335021
	1344.13	6.78874E-07	0.009231793	0.002306786
	1512.93	6.78874E-07	0.00928224	0.002310413
	1680.12	8.06163E-07	0.00928224	0.002328548

9/11/06 PP UPEA-2B Mass transfer calculations

Sample UPEA-2B

Amount of uranophane added =	0.4998 g
Amount of 0.0 M U solution added =	200.05 g
Total sample wt =	229.16 g
Wt of bottle =	28.61 g

Concentrations of components in starting solutions	mg/L	molality	moles
U	0.471595992	1.98125E-06	3.96348E-07
Ca	362.50	0.009044411	0.001809334
Si	63.5	0.002260591	0.000452231

Sampling data

Elapsed time (hrs)	Wt of bottle before sampling (g)	Wt of soln before sampling (g)	Wt of bottle after sampling (g)	Wt of soln removed (g)	pH	U (ppm)	Ca (ppm)	Si (ppm)
23.40	229.06	199.95	218.58	10.48	5.94	0.051	358.50	62.99
47.25	218.15	189.04	207.96	10.19	5.89	0.039	358.50	62.99
167.77	207.65	178.54	197.64	10.01	5.81	0.068	359.59	62.67
335.57	197.21	168.10	187.20	10.01	5.79	0.122	361.77	62.45
503.68	186.87	157.76	176.84	10.03	5.80	0.110	365.04	62.88
679.22	176.44	147.33	166.47	9.97	5.81	0.124	367.22	63.63
839.52	165.94	136.83	155.89	10.05	5.79	0.101	367.22	63.53
1007.57	155.70	126.59	145.78	9.92	5.80	0.204	368.31	63.42
1175.50	145.56	116.45	135.60	9.96	5.80	0.193	367.22	63.42
1344.12	135.23	106.12	125.27	9.96	5.79	0.162	368.31	63.63
1512.92	125.05	95.94	115.16	9.89	5.80	0.168	368.31	62.88
1680.13	114.91	85.80	105.01	9.90	5.79	0.207	370.49	63.85

Calculation of cumulative release (moles of U, Ca, Si released or precipitated as a function of time)

Defined by:

Cumulative moles released = (moles in soln at sampling time) + (moles extracted in all samples removed prior to sampling) - (initial moles in soln)

where

Moles in soln at sampling time = (measured molar concentration in sample) * (wt of soln before sampling) / 1000

Moles extracted during sampling = (measured molar concentration in sample) * (wt of soln removed during sampling) / 1000

	Elapsed time	Moles in soln at sampling time	Moles extracted during sampling	Moles extracted in all samples removed prior to sampling	Cumulative moles released
			0	0	
U	23.40	4.29376E-08	2.25049E-09	0	-3.53411E-07
	47.25	3.10099E-08	1.67155E-09	2.25049E-09	-3.63088E-07
	167.77	5.07396E-08	2.84476E-09	3.92204E-09	-3.41687E-07
	335.57	8.59478E-08	5.11801E-09	6.7668E-09	-3.03634E-07
	503.68	7.2595E-08	4.61541E-09	1.18848E-08	-3.11868E-07
	679.22	7.65838E-08	5.18251E-09	1.65002E-08	-3.03264E-07
	839.52	5.78917E-08	4.25207E-09	2.16827E-08	-3.16774E-07
	1007.57	1.08413E-07	8.49558E-09	2.59348E-08	-2.62E-07
	1175.50	9.42713E-08	8.06303E-09	3.44304E-08	-2.67647E-07
	1344.12	7.23442E-08	6.78992E-09	4.24934E-08	-2.81511E-07
	1512.92	6.78569E-08	6.99503E-09	4.92833E-08	-2.79208E-07
	1680.13	7.45768E-08	8.605E-09	5.62784E-08	-2.65493E-07
			0	0	
Ca	23.40	0.00178849	9.37402E-05	0	-2.08442E-05
	47.25	0.001690904	9.11463E-05	9.37402E-05	-2.46904E-05
	167.77	0.001601839	8.98084E-05	0.000184887	-2.26092E-05
	335.57	0.001517313	9.03527E-05	0.000274695	-1.73267E-05
	503.68	0.001436849	9.13513E-05	0.000365048	-7.43801E-06
	679.22	0.001349866	9.13469E-05	0.000456399	-3.07006E-06
	839.52	0.001253663	9.20799E-05	0.000547746	-7.92601E-06
	1007.57	0.001163284	9.11585E-05	0.000639826	-6.22516E-06
	1175.50	0.001066938	9.12553E-05	0.000730984	-1.14128E-05
	1344.12	0.000975177	9.15261E-05	0.000822239	-1.19177E-05
	1512.92	0.00088163	9.08828E-05	0.000913766	-1.39393E-05
	1680.13	0.000793115	9.1513E-05	0.001004648	-1.15713E-05
			0	0	
Si	23.40	0.000448366	2.35002E-05	0	-3.86518E-06
	47.25	0.000423902	2.28499E-05	2.35002E-05	-4.82941E-06
	167.77	0.000398307	2.23314E-05	4.63502E-05	-7.57416E-06
	335.57	0.00037373	2.22548E-05	6.86816E-05	-9.81995E-06
	503.68	0.000353156	2.24528E-05	9.09364E-05	-8.13888E-06
	679.22	0.000333754	2.25855E-05	0.000113389	-5.08789E-06
	839.52	0.000309444	2.27283E-05	0.000135975	-6.81212E-06
	1007.57	0.000285802	2.23963E-05	0.000158703	-7.72622E-06
	1175.50	0.000262909	2.24866E-05	0.000181099	-8.22291E-06
	1344.12	0.000240399	2.25629E-05	0.000203586	-8.2461E-06
	1512.92	0.000214768	2.21394E-05	0.000226149	-1.13144E-05
	1680.13	0.000195024	2.25027E-05	0.000248288	-8.91908E-06

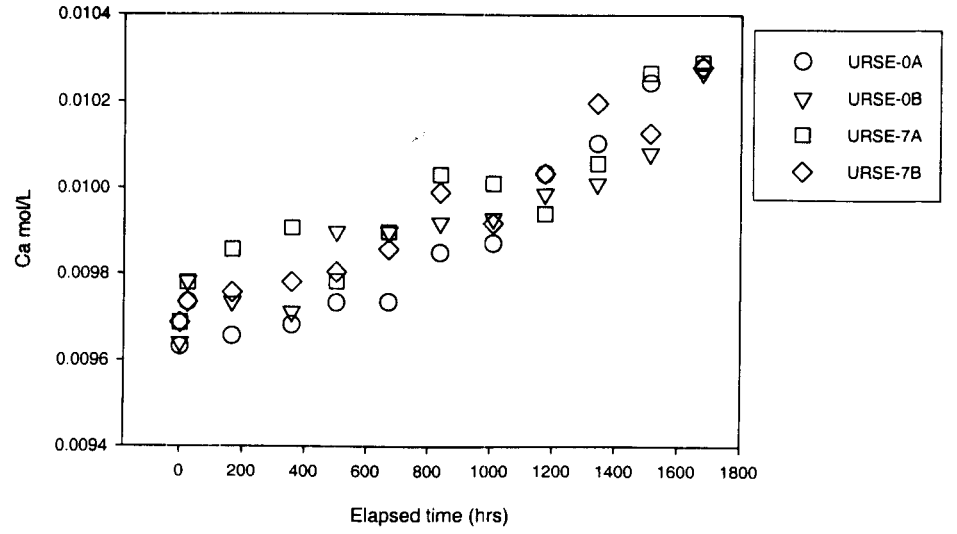
Molar concentration as a function of time	Elapsed time hours	U mol/L	Ca mol/L	Si mol/L
	0	1.98125E-06	0.009044411	0.002260591
	23.40	2.14742E-07	0.008944679	0.002242389
	47.25	1.64039E-07	0.008944679	0.002242389
	167.77	2.84192E-07	0.008971866	0.002230909
	335.57	5.11289E-07	0.009026241	0.002223256
	503.68	4.6016E-07	0.009107803	0.002238562
	679.22	5.19811E-07	0.009162178	0.002265348
	839.52	4.23092E-07	0.009162178	0.002261522
	1007.57	8.5641E-07	0.009189366	0.002257695
	1175.50	8.09541E-07	0.009162178	0.002257695
	1344.12	6.81719E-07	0.009189366	0.002265348
	1512.92	7.07284E-07	0.009189366	0.002238562
	1680.13	8.69192E-07	0.009243741	0.002273001

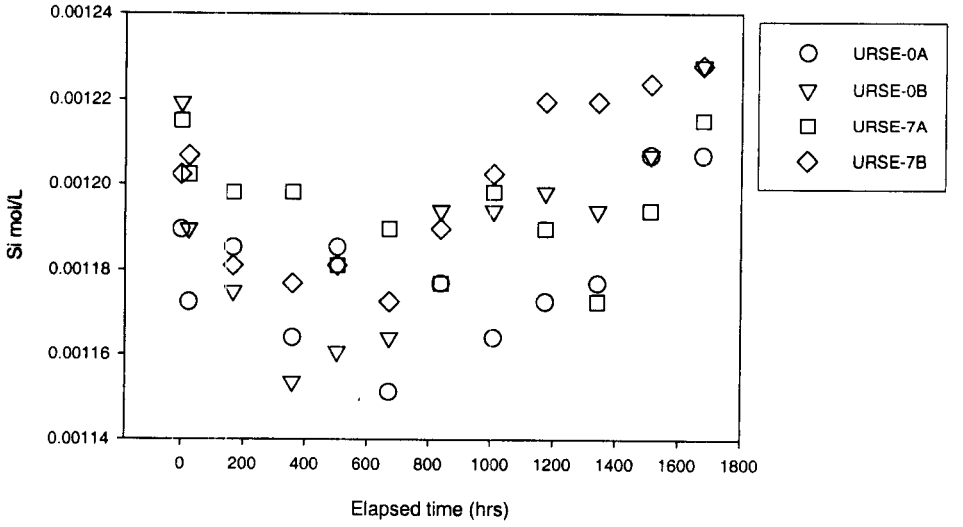
9/12/06 gp

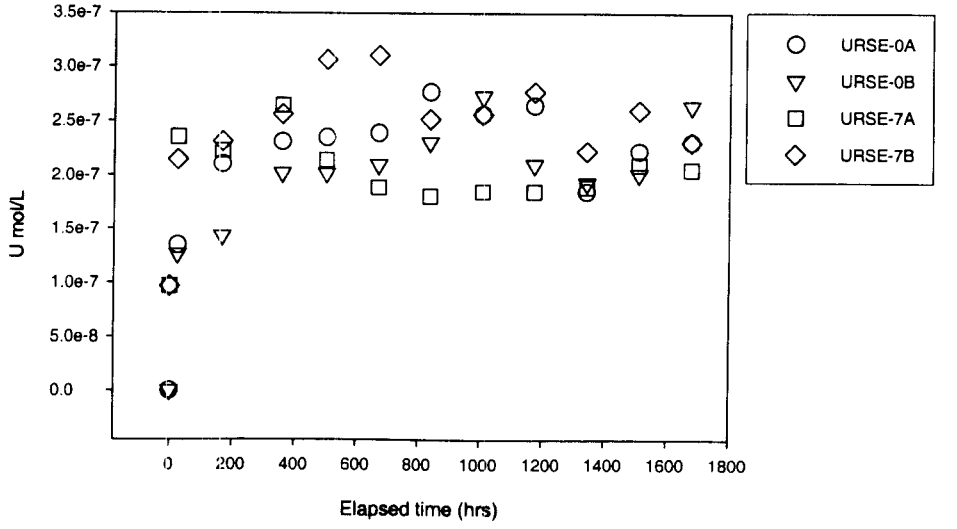
Plots of the concentration of Ca, Si, & U in the dissolution & precipitation tests, (URSE & UPEA) as a function of time follow:

9/12/06 gp

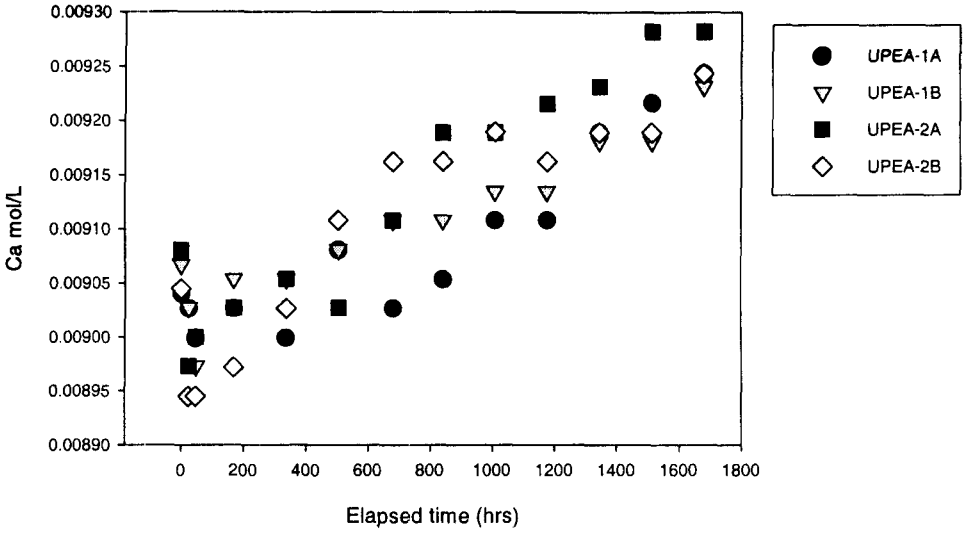
9/12/06 gp Experiment URSE - concentration plots

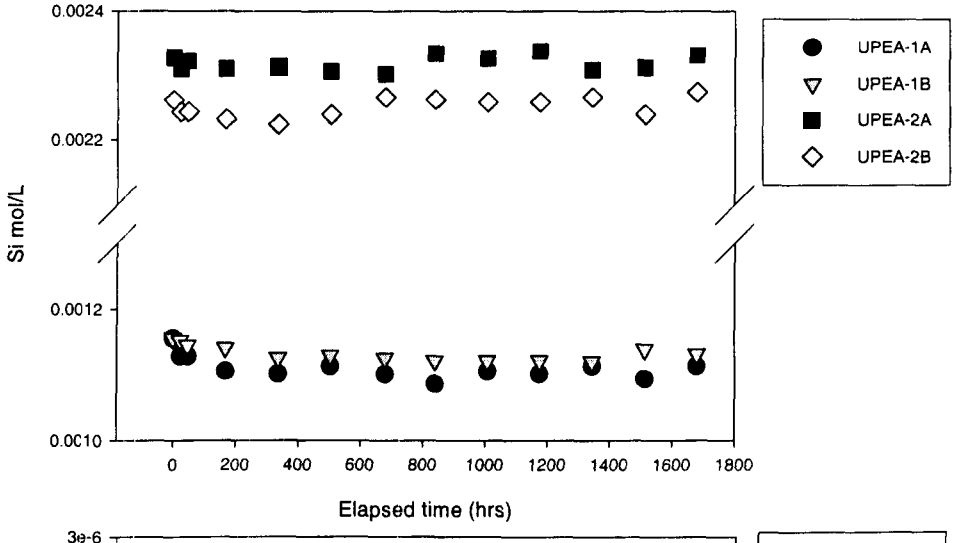


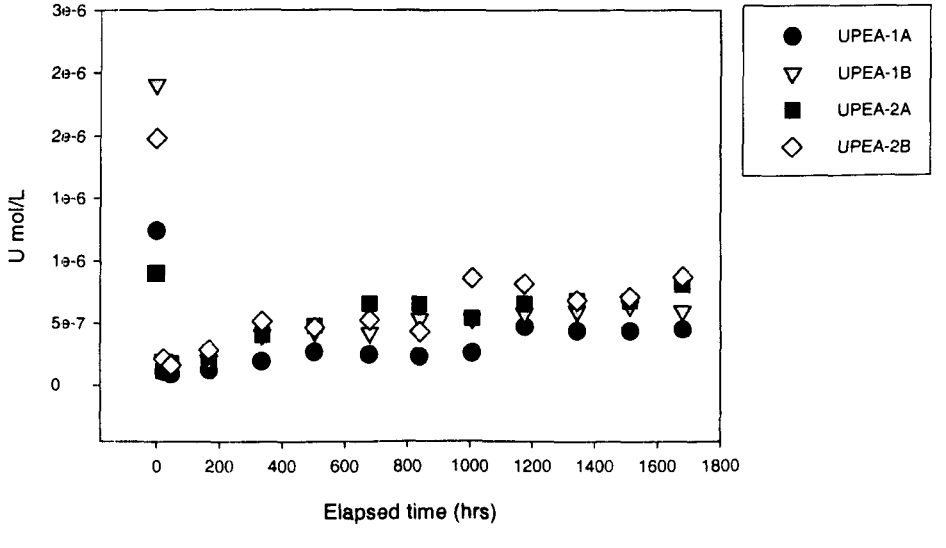




9/12/06 JP Experiment UPEA - concentration plots





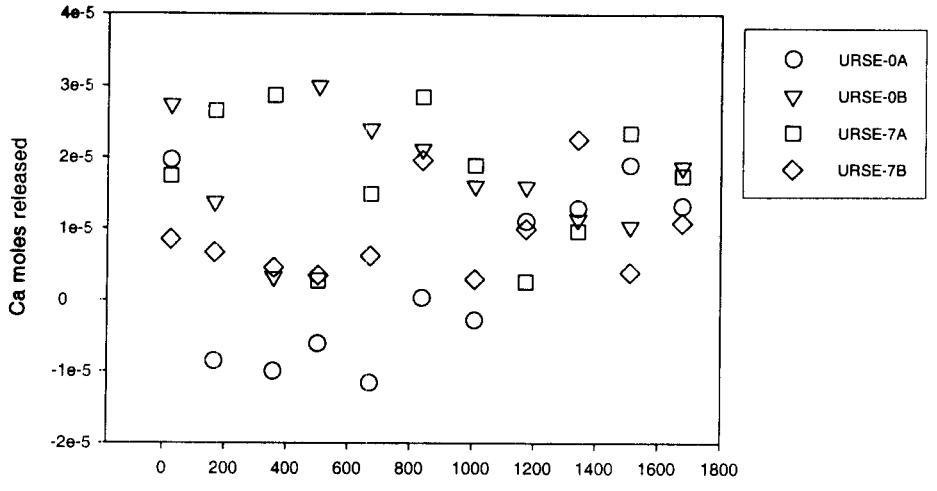


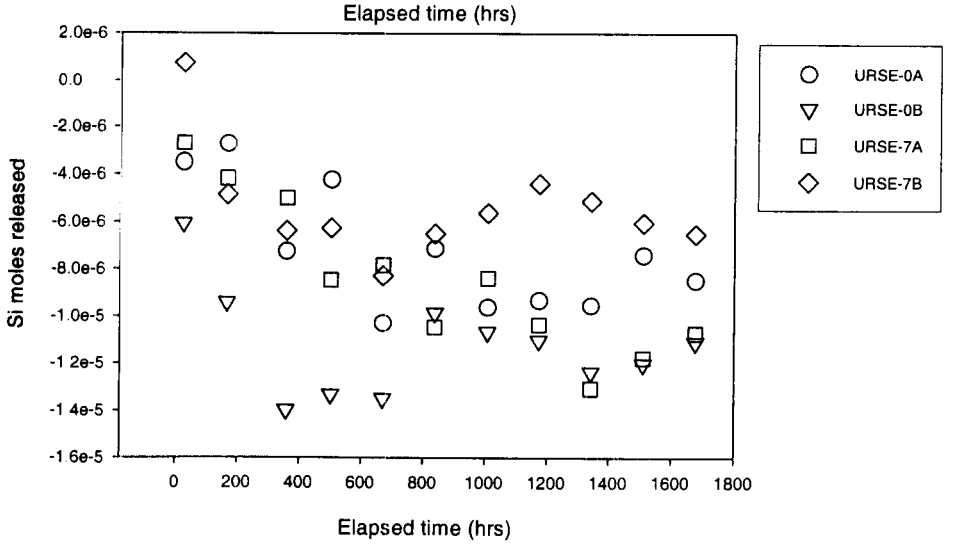
9/12/06 JP

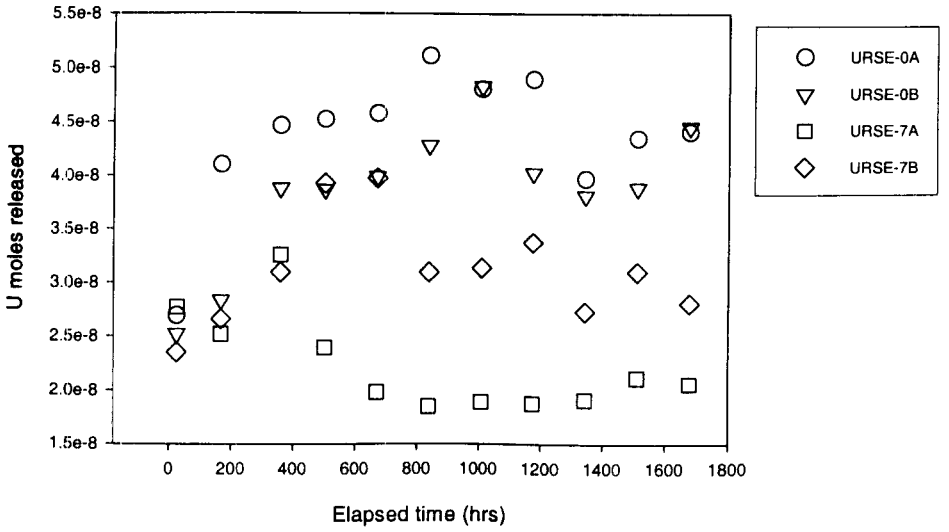
Plots of mass transfer of Ca, Si, + U in dissolution test URSE and precipitation test UPEA as a function of time follow:

JP 9/12/06

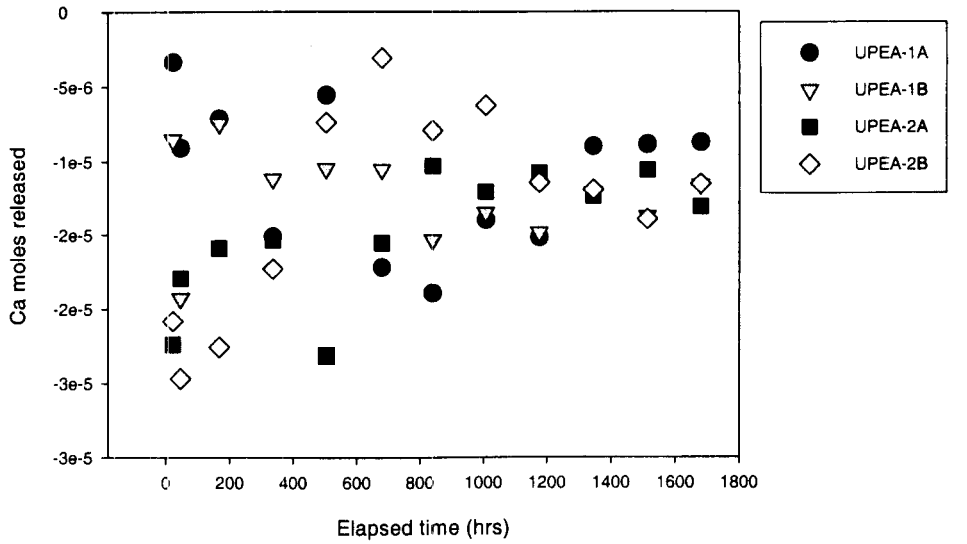
9/12/06 JJP Experiment URSE - mass transfer plots

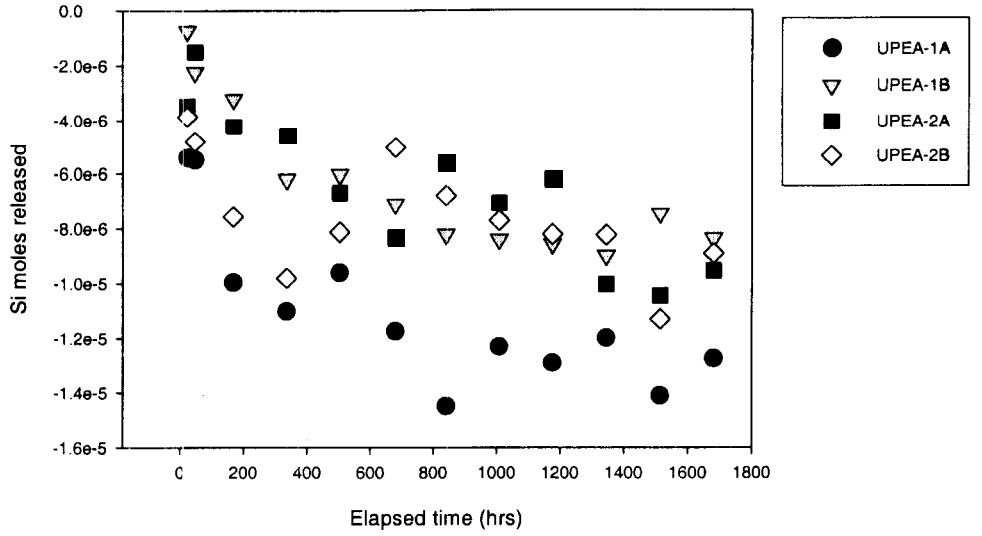


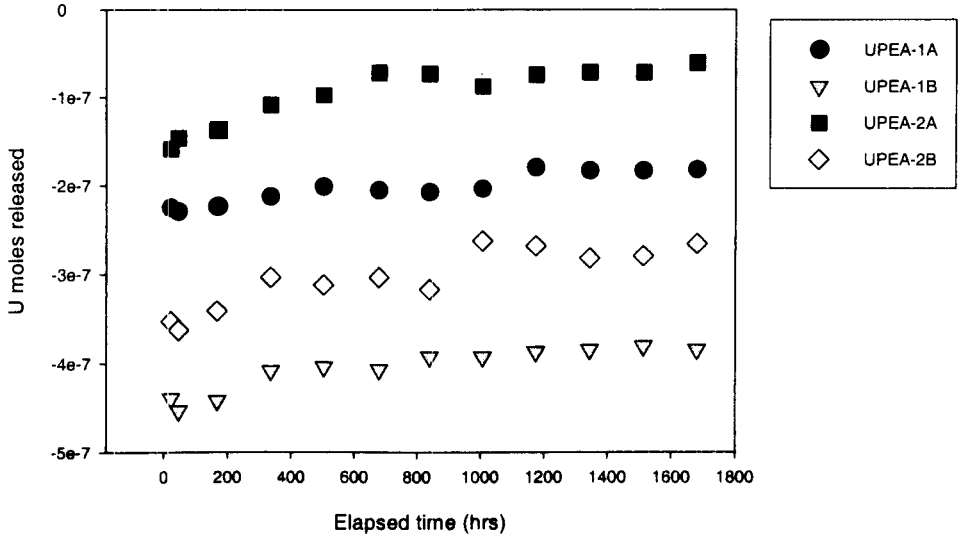




9/12/04 Eynat UPEA- mun transfer plots







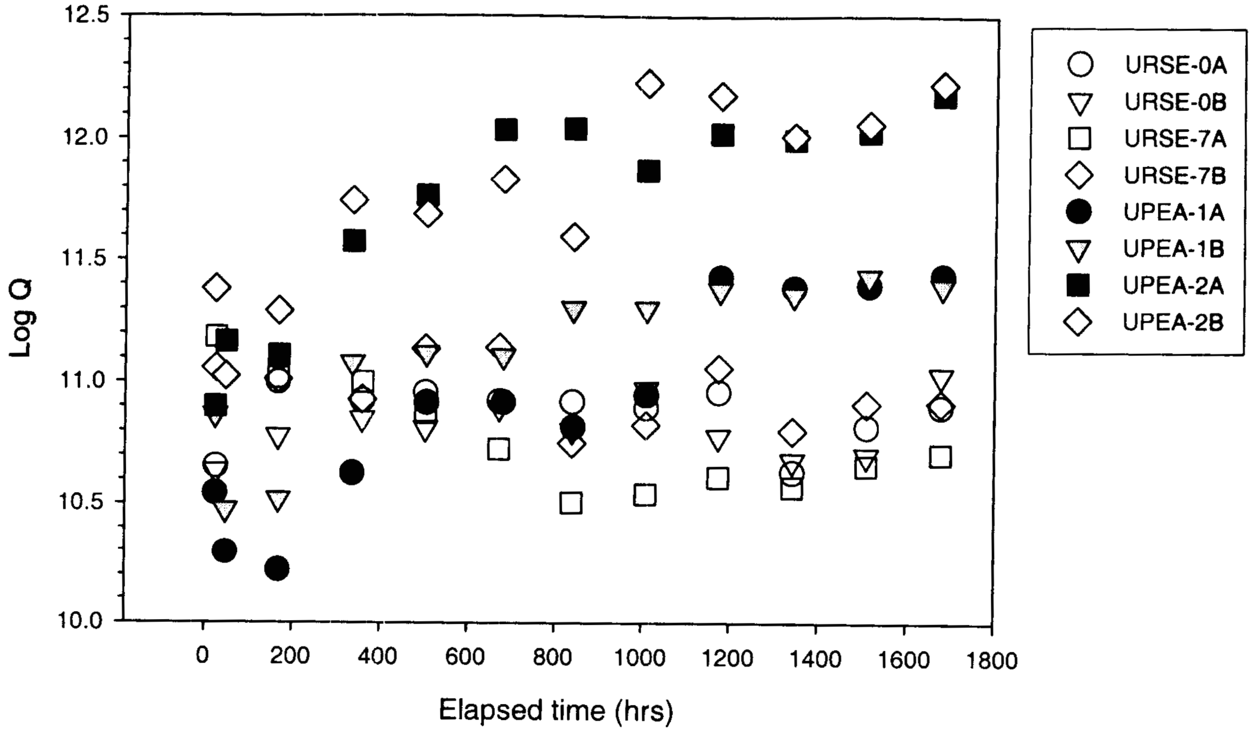
9/12/06 JP

Approximation of an equilibrium constant (log K) for minerals based on results of experiments URSE + UPEA.

Examination of the mass transfer data for experiments URSE + UPEA suggests that release of Ca, Si, + U was relatively steady in the latter parts of the experiments (e.g., in the last 4 sampling intervals). Up + down variation in release of Ca, Si, + U in the latter stages of the experiments were likely due to analytical and sampling errors.

A plot of calculated log Q's in experiments URSE + UPEA as a function of time is shown on the following page. The log Q plot shows that calculated values were also relatively steady in each test solution in the latter stages of the experiments.

9/12/06 [illegible]



For the last 4 sampling ~~intervals~~, the range of log Qs for samples in dissolution ~~test~~ URSE was 10.57 to 11.06 (see p 6-7) and the range of log Qs for samples in precipitation ~~test~~ UPEA was 11.36 to 12.22 (see p 8-9). The log Q midpoint separating these two ranges is 11.21 ((11.36 + 11.06)/2) and this value was taken as a good approximation for the uranophane equilibrium constant (Log K).

10/17/06 JF

Coprecipitation of Np in uranophane

Continuation of laboratory experiments to determine & evaluate Np incorporation into uranophane. Last entry for these experiments is on p 180 of scientific Notebook 582.

10/19/06 JF

A procedure for preparation of solution for a Np-uranophane coprecipitation experiment entitled "NPUA" is shown on the following pages.

JF 10/19/06

30 10/19/06 JJP

Preparation of solutions for Np-uranophane coprecipitation experiment NPUA

Written by: J. D. Prikryl
Date: 10/17/06

Objective: Prepare solutions containing U, Np, Ca, Na, and SiO_2 for use in Np-uranophane coprecipitation tests. Solutions will have a Ca content of 10^{-2} M to 1.5 x 10^{-2} M and a SiO_2 content of 10^{-3} M. U contents will be 1.0 x 10^{-5} M (2.38 ppm). Np contents will be 4.33 x 10^{-7} M (0.1 ppm), 1.08 x 10-6 M (0.25 ppm) or 1.73 x 10^{-6} M (0.4 ppm). Solutions will have Na contents of 0.0 ppm, 8.7 x 10^{-5} M (2 ppm), and 4.35 x10^{-4} M (10 ppm). The pH of the solutions will be approximately 6.0.

Method: Addition of chemical reagents containing Ca, Np, Na, and U to an approximate 10^{-3} M SiO_2 solution.

Materials and Equipment:

- Previously prepared 10^{-3} M SiO_2 solution (scientific notebook 325, p. 73-74)
- Np standard solution #61A (102.55 ppm Np; 4.33 x 10^{-4} M Np, see scientific notebook 582, p. 177)
- $CaCl_2 \cdot 2H_2O$; F.W. 147.02; (lot no. 061720)
- $UO_2(NO_3)_2 \cdot 6H_2O$; F.W. 502.13; (lot no. 3640 KCAP)
- $CaCO_3$; F.W. 100.09; (lot no. 986396)
- NaCl; F.W. 58.44; (lot no. 984321)
- Polypropylene bottles; various volumes
- 30 ml LDPE bottles
- Orion pH meter
- Orion combination pH electrode
- ATC probe
- pH buffer solutions
- Mettler analytical balances (AE240 and PR5002)
- weighing paper and boats
- Gyratory shaker

Procedure

10/19/06 JJP

1. Transfer 100 g of the previously prepared 10^{-3} M SiO_2 solution to a 250 ml polypropylene bottle. Add 0.0502 g of $UO_2(NO_3)_2 \cdot 6H_2O$ to the bottle. Label the bottle as 10^{-3} m U.

10/19/06 JJP

2. Label 12 250 ml polypropylene bottles as follows:

0.0 ppm Np
0.1 ppm Np
0.25 ppm Np
0.4 ppm Np
0.0 ppm Np/2.0 ppm Na
0.1 ppm Np/2.0 ppm Na
0.25 ppm Np/2.0 ppm Na
0.4 ppm Np/2.0 ppm Na
0.0 ppm Np/10.0 ppm Na
0.1 ppm Np/10.0 ppm Na
0.25 ppm Np/10.0 ppm Na
0.4 ppm Np/10.0 ppm Na

10/19/06 JF

3. Transfer about 50 g of the previously prepared $1x10^{-3}$ M SiO_2 solution into the 12 bottles listed above.

10/19/06 JF

4. Carefully add the following quantities of chemicals and reagents listed below to the specified bottle. Use weighing paper and weigh out reagents as accurately as possible. After adding reagents make up to a final weight of 200 g with the 10^{-3} M SiO_2 solution.

Bottle Label	$CaCl_2 \cdot 2H_2O$	$CaCO_3$	1000 ppm Na soln	10^{-3} M U soln	$4.33x10^{-4}$ M Np soln
0.0 ppm Np	0.2940 g	0.00006 g	0 g	2.0 g	0 g
0.1 ppm Np	0.1911 g	0.0703 g	0 g	2.0 g	0.2 g
0.25 ppm Np	0.0590 g	0.1754 g	0 g	2.0 g	0.5 g
0.4 ppm Np	0.0294 g	0.2805 g	0 g	2.0 g	0.8 g
0.0 ppm Np/2.0 ppm Na	0.2940 g	0.00006 g	0.4 g	2.0 g	0 g
0.1 ppm Np/2.0 ppm Na	0.1911 g	0.0703 g	0.4 g	2.0 g	0.2 g
0.25 ppm Np/2.0 ppm Na	0.0590 g	0.1754 g	0.4 g	2.0 g	0.5 g
0.4 ppm Np/2.0 ppm Na	0.0294 g	0.2805 g	0.4 g	2.0 g	0.8 g
0.0 ppm Np/10 ppm Na	0.2940 g	0.00006 g	2.0 g	2.0 g	0 g
0.1 ppm Np/10 ppm Na	0.1911 g	0.0703 g	2.0 g	2.0 g	0.2 g
0.25 ppm Np/10 ppm Na	0.0590 g	0.1754 g	2.0 g	2.0 g	0.5 g
0.4 ppm Np/10 ppm Na	0.0294 g	0.2805 g	2.0 g	2.0 g	0.8 g

10/19/06 JF

5. Allow solutions to equilibrate with air by loosely capping bottles and placing on a gryratory shaker.

6. Every 3 or 4 days measure and record pH to determine when solutions reach equilibrium with air. Note: the pH of the solutions may have to be adjusted to reach the desired pH of about 6 by addition of acid (HNO_3) or base ($CaCO_3$).

7. When equilibrium is reached (i.e., when pH is stable) record the weight of each solution bottle.

250 ml PP Bottle	Wt (g)
0.0 ppm Np	
0.1 ppm Np	
0.25 ppm Np	
0.4 ppm Np	
0.0 ppm Np/2.0 ppm Na	
0.1 ppm Np/2.0 ppm Na	
0.25 ppm Np/2.0 ppm Na	
0.4 ppm Np/2.0 ppm Na	
0.0 ppm Np/10 ppm Na	
0.1 ppm Np/10 ppm Na	
0.25 ppm Np/10 ppm Na	
0.4 ppm Np/10 ppm Na	

Note: pHs recorded on p 33
JF 10/19/06

11/9/06 JF This procedure was abandoned (see p 44 for explanation).

10/19/06 9P

8. Label and weight 12 30 ml LDPE bottles as below. Take a ~28 g sample aliqout from each solution and place in corresponding 30 ml LDPE bottle for gamma counting. Weight bottles and record. Gamma counting will show the initial Np contents of the solutions before addition of uranophane.

30 ml LDPE Bottle	Wt of bottle (g)	Wt of bottle + sample (g)	Wt of sample (g)
0.0 ppm Np			
0.1 ppm Np			
0.25 ppm Np			
0.4 ppm Np			
0.0 ppm Np/2.0 ppm Na			
0.1 ppm Np/2.0 ppm Na			
0.25 ppm Np/2.0 ppm Na			
0.4 ppm Np/2.0 ppm Na			
0.0 ppm Np/10 ppm Na			
0.1 ppm Np/10 ppm Na			
0.25 ppm Np/10 ppm Na			
0.4 ppm Np/10 ppm Na			

9. After sampling record the weight of each 250 ml solution bottle.

250 ml PP Bottle	Wt (g)
0.0 ppm Np	
0.1 ppm Np	
0.25 ppm Np	
0.4 ppm Np	
0.0 ppm Np/2.0 ppm Na	
0.1 ppm Np/2.0 ppm Na	
0.25 ppm Np/2.0 ppm Na	
0.4 ppm Np/2.0 ppm Na	
0.0 ppm Np/10 ppm Na	
0.1 ppm Np/10 ppm Na	
0.25 ppm Np/10 ppm Na	
0.4 ppm Np/10 ppm Na	

10. After measuring the Np contents of the 28 g sample aliqouts by gamma counting (# 8 above), acidify each sample by addition of HNO_3. Take two 10 ml sample aliqouts from each sample solution and place in 15 ml polypropylene bottles for cation analysis by ICP. Use an Oxford pipettor and 10 ml plastic tips to take samples. Chemical analysis will show the initial Ca, SiO_2, Na, and U contents of solutions before addition of uranophane. Label samples as shown below.

10 ml PP Bottle	Label
0.0 ppm Np	NPUA-M1; NPUA-M2
0.1 ppm Np	NPUA-M3; NPUA-M4
0.25 ppm Np	NPUA-M5; NPUA-M6
0.4 ppm Np	NPUA-M7; NPUA-M8
0.0 ppm Np/2.0 ppm Na	NPUA-M9; NPUA-M10
0.1 ppm Np/2.0 ppm Na	NPUA-M11; NPUA-M12
0.25 ppm Np/2.0 ppm Na	NPUA-M13; NPUA-M14
0.4 ppm Np/2.0 ppm Na	NPUA-M15; NPUA-M16
0.0 ppm Np/10 ppm Na	NPUA-M17; NPUA-M18
0.1 ppm Np/10 ppm Na	NPUA-M19; NPUA-M20
0.25 ppm Np/10 ppm Na	NPUA-M21; NPUA-M22
0.4 ppm Np/10 ppm Na	NPUA-M23; NPUA-M24

10/23/06 gp

pH measurements of NPuA solutions

Sample	gp 10/24/06	gp 10/24/06	gp 10/27/06	gp 10/30/06
0.0 ppm Np	6.05	6.02	—	6.03
0.1 ppm Np	7.56	7.52/6.14 add 0.8ml 1M HNO_3	add 0.25ml 3M HNO_3	5.83 add 0.3ml 3M HNO_3
0.25 ppm Np	7.78	7.75/6.20 add 0.9ml 1M HNO_3	add 0.3ml 3M HNO_3	5.80 add 0.3ml 3M HNO_3
0.4 ppm Np	7.93	7.90/6.20 add 1.1ml 1M HNO_3	7.90/6.00 add 0.4ml 3M HNO_3	5.70 add 0.3ml 3M HNO_3
0.0 ppm Np/2.0 ppm Na	6.84	6.50/5.45 add 0.1ml 1M HNO_3	5.90	5.94
0.1 ppm Np/2.0 ppm Na	7.60	add 0.8ml 1M HNO_3	add 0.25ml 3M HNO_3	5.68 add 0.2ml 3M HNO_3
0.25 ppm Np/2.0 ppm Na	7.80	add 0.9ml 1M HNO_3	7.65/6.00 add 0.3ml 3M HNO_3	5.60 add 0.3ml 3M HNO_3
0.4 ppm Np/2.0 ppm Na	7.88	add 1.1ml 1M HNO_3	add 0.4ml 3M HNO_3	5.80 add 0.05ml 3M HNO_3
0.0 ppm Np/10 ppm Na	6.81	6.51/6.12 add 0.3ml 0.1N HNO_3	6.40/6.00 add 0.1ml 1M HNO_3	5.61
0.1 ppm Np/10 ppm Na	7.56	add 0.8ml 1M HNO_3	7.45/6.00 add 0.25ml 3M HNO_3	5.96 add 0.2ml 3M HNO_3
0.25 ppm Np/10 ppm Na	7.82	add 0.9ml 1M HNO_3	add 0.3ml 3M HNO_3	5.82 add 0.3ml 3M HNO_3
0.4 ppm Np/10 ppm Na	7.89	add 1.1ml 1M HNO_3	add 0.4ml 3M HNO_3	5.90 add 0.03ml 3M HNO_3

* 0.05ml 3M HNO_3

11/9/06 gp This procedure was abandoned (see p 44 for explanation).

10/24/06 gp

Calibration check for county Np in solution

Efficiencies for county Np in solution using gamma spectrometry were determined previously using calibrated standard 1168-85 (see notebook 582 pgs. 164-172)

To check the validity of the determined efficiencies, Np237 calibrated standard was counted 3 times and its activity was calculated using the previously determined county efficiencies. Results are shown on the following page.

10/27/06 gp Calculated activities for 1168 85 were

1535.44 dpm/g
1540.43 dpm/g
1537.44 dpm/g

These activities compare well with the NIST certified activity of 1168-85, which is 1518.05 dpm/g and indicates that the previously determined county efficiencies for Np in solution are valid.

Np/Uranophane solution analysis

Sample = **1168-85**
Sample wt (g) = **28.24015**

Bq conversion 0.037 Bq per 2.2 dpm = 0.0168 Bq/dpm

Measured Np concentration based on gamma counting

Sample activity = total counts / (counting efficiency * % yield * counting time)

Np-237
Abundances (%yield) taken from IAEA Nudat database

Energy keV	ROI channels	Total counts	Efficiency	% yield	time (m)	Sample wt (g)	Activity (dpm)	Activity (dpm/g)	Activity (Bq/g)	ppb	ppm	molality	moles
29.37	Genie	74700	0.1037	0.1412	120	28.24	42509.363	1505.281	25.3161	970.30815	0.9703081	4.09326E-06	1.16E-07
57.1	Genie	2100	0.1234	0.00354	120	28.24	40071.152	1418.943	23.864	914.65416	0.9146542	3.85849E-06	1.09E-07
86.48	Genie	93200	0.1396	0.124	120	28.24	44859.238	1588.491	26.7155	1023.9458	1.0239458	4.31954E-06	1.22E-07
92.28	Genie	11400	0.1324	0.0166	120	28.24	43223.65	1530.574	25.7415	986.6123	0.9866123	4.16204E-06	1.18E-07
95.86	Genie	18800	0.1351	0.0268	120	28.24	43284.195	1532.718	25.7775	987.99429	0.9879943	4.16787E-06	1.18E-07
108.43	Genie	5750	0.1107	0.01031	120	28.24	41969.556	1486.166	24.9946	957.98665	0.9579866	4.04129E-06	1.14E-07
143.25	Genie	2440	0.0935	0.00443	120	28.24	49109.035	1738.979	29.2465	1120.9506	1.1209506	4.72875E-06	1.34E-07
						Average =	43361.159	1535.444	25.8234	989.75103	0.989751	4.17528E-06	1.18E-07

Np-237
Abundances (%yield) taken from IAEA Nudat database

Energy keV	ROI channels	Total counts	Efficiency	% yield	time (m)	Sample wt (g)	Activity (dpm)	Activity (dpm/g)	Activity (Bq/g)	ppb	ppm	molality	moles
29.37	Genie	73000	0.1037	0.1412	120	28.24	41541.947	1471.024	24.74	948.22617	0.9482262	4.00011E-06	1.13E-07
57.1	Genie	2110	0.1234	0.00354	120	28.24	40261.967	1425.699	23.9777	919.00966	0.9190097	3.87686E-06	1.09E-07
86.48	Genie	91700	0.1396	0.124	120	28.24	44137.254	1562.926	26.2856	1007.466	1.007466	4.25001E-06	1.2E-07
92.28	Genie	11600	0.1324	0.0166	120	28.24	43981.96	1557.427	26.1931	1003.9213	1.0039213	4.23506E-06	1.2E-07
95.86	Genie	19200	0.1351	0.0268	120	28.24	44205.136	1565.329	26.326	1009.0154	1.0090154	4.25655E-06	1.2E-07
108.43	Genie	5880	0.1107	0.01031	120	28.24	42918.433	1519.766	25.5597	979.64548	0.9796455	4.13265E-06	1.17E-07
143.25	Genie	2390	0.0935	0.00443	120	28.24	48102.702	1703.344	28.6472	1097.9803	1.0979803	4.63185E-06	1.31E-07
						Average =	43502.024	1540.432	25.9073	992.96639	0.9929664	4.18885E-06	1.18E-07

Np-237
Abundances (%yield) taken from IAEA Nudat database

Energy keV	ROI channels	Total counts	Efficiency	% yield	time (m)	Sample wt (g)	Activity (dpm)	Activity (dpm/g)	Activity (Bq/g)	ppb	ppm	molality	moles
29.37	Genie	72900	0.1037	0.1412	120	28.24	41485.041	1469.009	24.7061	946.92723	0.9469272	3.99463E-06	1.13E-07
57.1	Genie	2270	0.1234	0.00354	120	28.24	43315.007	1533.809	25.7959	988.69759	0.9886976	4.17084E-06	1.18E-07
86.48	Genie	92400	0.1396	0.124	120	28.24	44474.18	1574.856	26.4862	1015.1566	1.0151566	4.28246E-06	1.21E-07
92.28	Genie	11400	0.1324	0.0166	120	28.24	43223.65	1530.574	25.7415	986.6123	0.9866123	4.16204E-06	1.18E-07
95.86	Genie	19100	0.1351	0.0268	120	28.24	43974.901	1557.177	26.1889	1003.7602	1.0037602	4.23438E-06	1.2E-07
108.43	Genie	6280	0.1107	0.01031	120	28.24	45838.054	1623.152	27.2985	1046.288	1.046288	4.41379E-06	1.25E-07
143.25	Genie	2120	0.0935	0.00443	120	28.24	42668.506	1510.916	25.4109	973.94071	0.9739407	4.10859E-06	1.16E-07
						Average =	43417.526	1537.44	25.8569	991.03767	0.9910377	4.18071E-06	1.18E-07

10/27/06

35

10/27/06 JP

An additional check on the validity of the previously determined cavity efficiency for Np in solution (see SN 582 p 164-172) was performed by counting sample 61D which had a previously calculated activity of 1713.21 dpm/g (see SN 582 p 177).

Results are shown on the following page.

The calculated activities of 61D were

1728.20 dpm/g
1688.75 dpm/g
1691.19 dpm/g

The values compare well with the previously calculated activity of 61D and indicate that previously determined efficiencies for cavity Np in solution are valid.

JP 10/27/06

Np/Uranophane solution analysis

Sample = **61D**
Sample wt (g) = **28.22**

Bq conversion 0.037 Bq per 2.2 dpm = 0.0168 Bq/dpm

Measured Np concentration based on gamma counting

Sample activity = total counts / (counting efficiency * % yield * counting time)

Np-237
Abundances (%yield) taken from IAEA Nudat database

Energy keV	ROI channels	Total counts	Efficiency	% yield	time (m)	Sample wt (g)	Activity (dpm)	Activity (dpm/g)	Activity (Bq/g)	ppb	ppm	molality	moles
~~29.37~~	~~Genie~~	~~82300~~	~~0.1037~~	~~0.1412~~	~~120~~	~~28.22~~	~~46834.278~~	~~1659.613~~	~~27.9117~~	~~1069.7909~~	~~1.0697909~~	~~4.51293E-06~~	~~1.27E-07~~
57.1	Genie	2490	0.1234	0.00354	120	28.22	47512.938	1683.662	28.3161	1085.2929	1.0852929	4.57833E-06	1.29E-07
86.48	Genie	100300	0.1396	0.124	120	28.22	48276.626	1710.724	28.7713	1102.7371	1.1027371	4.65192E-06	1.31E-07
92.28	Genie	13000	0.1324	0.0166	120	28.22	49290.127	1746.638	29.3753	1125.8875	1.1258875	4.74958E-06	1.34E-07
95.86	Genie	21500	0.1351	0.0268	120	28.22	49500.543	1754.094	29.5007	1130.6939	1.1306939	4.76985E-06	1.35E-07
108.43	Genie	6460	0.1107	0.01031	120	28.22	47151.883	1670.868	28.101	1077.0457	1.0770457	4.54354E-06	1.28E-07
143.25	Genie	2600	0.0935	0.00443	120	28.22	52329.3	1854.334	31.1865	1195.3085	1.1953085	5.04243E-06	1.42E-07
						Average =	48769.845	1728.201	29.0652	1114.0032	1.1140032	4.69944E-06	1.33E-07

Np-237
Abundances (%yield) taken from IAEA Nudat database

Energy keV	ROI channels	Total counts	Efficiency	% yield	time (m)	Sample wt (g)	Activity (dpm)	Activity (dpm/g)	Activity (Bq/g)	ppb	ppm	molality	moles
29.37	Genie	82300	0.1037	0.1412	120	28.22	46834.278	1659.613	27.9117	1069.7909	1.0697909	4.51293E-06	1.27E-07
57.1	Genie	2440	0.1234	0.00354	120	28.22	46558.862	1649.853	27.7475	1063.4999	1.0634999	4.48639E-06	1.27E-07
86.48	Genie	102000	0.1396	0.124	120	28.22	49094.874	1739.719	29.2589	1121.4276	1.1214276	4.73076E-06	1.34E-07
92.28	Genie	12600	0.1324	0.0166	120	28.22	47773.508	1692.895	28.4714	1091.2448	1.0912448	4.60344E-06	1.3E-07
95.86	Genie	21100	0.1351	0.0268	120	28.22	48579.602	1721.46	28.9518	1109.6577	1.1096577	4.68111E-06	1.32E-07
108.43	Genie	6230	0.1107	0.01031	120	28.22	45473.101	1611.378	27.1005	1038.6988	1.0386988	4.38177E-06	1.24E-07
143.25	Genie	2520	0.0935	0.00443	120	28.22	50719.167	1797.277	30.2269	1158.5297	1.1585297	4.88728E-06	1.38E-07
						Average =	47656.42	1688.746	28.4016	1088.5703	1.0885703	4.59215E-06	1.3E-07

Np-237
Abundances (%yield) taken from IAEA Nudat database

Energy keV	ROI channels	Total counts	Efficiency	% yield	time (m)	Sample wt (g)	Activity (dpm)	Activity (dpm/g)	Activity (Bq/g)	ppb	ppm	molality	moles
29.37	Genie	83300	0.1037	0.1412	120	28.22	47403.346	1679.778	28.2508	1082.7896	1.0827896	4.56777E-06	1.29E-07
57.1	Genie	2400	0.1234	0.00354	120	28.22	45795.602	1622.807	27.2927	1046.0654	1.0460654	4.41285E-06	1.25E-07
86.48	Genie	104000	0.1396	0.124	120	28.22	50057.519	1773.831	29.8326	1143.4163	1.1434163	4.82352E-06	1.36E-07
92.28	Genie	13000	0.1324	0.0166	120	28.22	49290.127	1746.638	29.3753	1125.8875	1.1258875	4.74958E-06	1.34E-07
95.86	Genie	21500	0.1351	0.0268	120	28.22	49500.543	1754.094	29.5007	1130.6939	1.1306939	4.76985E-06	1.35E-07
108.43	Genie	6200	0.1107	0.01031	120	28.22	45254.13	1603.619	26.97	1033.6971	1.0336971	4.36067E-06	1.23E-07
143.25	Genie	2440	0.0935	0.00443	120	28.22	49109.035	1740.221	29.2674	1121.751	1.121751	4.73213E-06	1.34E-07
						Average =	47725.464	1691.193	28.4428	1090.1474	1.0901474	4.59881E-06	1.3E-07

10/27/06 JF

10/31/06 JF

Calibration check for cavity Np in uranophane

Efficiencies for cavity Np in uranophane were determined (gamma spectrometry) previously (see p 185-190 in scientific notebook 582)

Using these efficiencies the actual ^{237}Np + calculated concentrations in calibrate standards Cal-2b and Cal-4a were determined. From previous counts of these standards (see p 190 in scientific notebook 582). Results are shown on the following pages and indicate that Standard Cal-2b has a ^{237}Np concentration of about 128.8 ppm and Standard Cal-4a has a ^{237}Np concentration of about 99.8 ppm.

Calculated activities were

Cal-2b = 199804 dpm/g
Cal-4a = 154860 dpm/g

10/31/04

Np/Uranophane solid analysis

Sample = **Cal-2b**
Sample wt (g) = **0.1039**

Bq conversion 0.037 Bq per 2.2 dpm = 0.0168 Bq/dpm

Measured Np concentration based on gamma counting

Sample activity = total counts / (counting efficiency * % yield * counting time)

Uranophane reference peak counts

Energy keV	dpm/g
92.28	5991.79
95.86	27.27
143.25	141.79

Np-237

Abundances (%yield) taken from IAEA Nudat database

Energy keV	ROI channels	Total counts	Estimated Uranophane counts	Corrected counts	Efficiency	% yield	time (m)	Sample wt (g)	Activity (dpm)	Activity (dpm/g)	Activity (Bq/g)	ppb	ppm	molality	moles
29.37	Genie	46266.7	0	46266.7	0.1356	0.1412	120	0.1039	20136.91	193811	3259.5405	124930.773	124.9308	0.000527	5.48E-08
57.1	Genie	2050	0	2050	0.2258	0.0035	120	0.1039	21372.01	205698	3459.4648	132593.413	132.5934	0.000559	5.81E-08
86.48	Genie	98200	0	98200	0.3244	0.124	120	0.1039	20343.6	195800	3292.996	126213.046	126.213	0.000532	5.53E-08
92.28	Genie	83333.3	74705.6377	8627.662	0.1977	0.0166	120	0.1039	21907.72	210854	3546.1788	135916.965	135.917	0.000573	5.96E-08
95.86	Genie	19700	340.00236	19360	0.2981	0.0268	120	0.1039	20194.23	194362	3268.8183	125286.368	125.2864	0.000529	5.49E-08
108.43	Genie	8600	0	8600	0.3366	0.0103	120	0.1039	20651.16	198760	3342.781	128121.19	128.1212	0.00054	5.62E-08
143.25	Genie	4203.33	1767.83772	2435.492	0.2212	0.0044	120	0.1039	20711.74	199343	3352.5878	128497.062	128.4971	0.000542	5.63E-08
								Average =	20759.62	199804	3360.3382	128794.117	128.7941	0.000543	5.65E-08

10
10/31/06

Np/Uranophane solid analysis

Sample = **Cal-4a**
Sample wt (g) = **0.1031**

Bq conversion 0.037 Bq per 2.2 dpm = 0.0168 Bq/dpm

Measured Np concentration based on gamma counting

Sample activity = total counts / (counting efficiency * % yield * counting time)

Uranophane reference peak counts

Energy keV	dpm/g
92.28	5991.79
95.86	27.27
143.25	141.79

Np-237
Abundances (%yield) taken from IAEA Nudat database

Energy keV	ROI channels	Total counts	Estimated Uranophane counts	Corrected counts	Efficiency	% yield	time (m)	Sample wt (g)	Activity (dpm)	Activity (dpm/g)	Activity (Bq/g)	ppb	ppm	molality	moles
29.37	Genie	36766.7	0	36766.7	0.1356	0.1412	120	0.1031	16002.18	155210	2610.3539	100048.927	100.0489	0.000422	4.35E-08
57.1	Genie	1576.67	0	1576.67	0.2258	0.0035	120	0.1031	16437.37	159431	2681.3452	102769.863	102.7699	0.000434	4.47E-08
86.48	Genie	78266.7	0	78266.7	0.3244	0.124	120	0.1031	16214.11	157266	2644.9266	101374.019	101.374	0.000428	4.41E-08
92.28	Genie	80500	74130.4259	6369.574	0.1977	0.0166	120	0.1031	16173.89	156876	2638.3644	101122.503	101.1225	0.000427	4.4E-08
95.86	Genie	16100	337.38444	15762.62	0.2981	0.0268	120	0.1031	16441.83	159475	2682.0733	102797.768	102.7978	0.000434	4.47E-08
108.43	Genie	6586.67	0	6586.67	0.3366	0.0103	120	0.1031	15816.55	153410	2580.0746	98888.3887	98.88839	0.000417	4.3E-08
143.25	Genie	3480	1754.22588	1725.774	0.2212	0.0044	120	0.1031	14676.21	142349	2394.0556	91758.7049	91.7587	0.000387	3.99E-08
								Average =	15966.02	154860	2604.4562	99822.882	99.82288	0.000421	4.34E-08

10/31/06 gp

To check the validity of the determined efficiencies, Standards Cal-2b and Cal-4a were counted 3 times & activities and concentrations were calculated using the previously determined county efficiencies. Results are shown on the following pages.

Calculated activities for Cal-2b were

199823 dpm/g
197036 dpm/g
198304 dpm/g

which compare well to previously measured activity of 199804 dpm/g.

Calculated for Cal-4a were

157162 dpm/g
150678 dpm/g
157711 dpm/g

which compare well to previously measured ^{237}Np activity of 154860 dpm/g.

This analysis indicates that the previously determined county efficiencies for Np in soil samples are valid.

Np/Uranophane solid analysis

Sample = **Cal-2b**
Sample wt (g) = **0.1039**

Bq conversion 0.037 Bq per 2.2 dpm = 0.0168 Bq/dpm

Measured Np concentration based on gamma counting

Sample activity = total counts / (counting efficiency * % yield * counting time)

Uranophane reference peak counts

Energy keV	dpm/g
92.28	5991.79
95.86	27.27
143.25	141.79

Np-237
Abundances (%yield) taken from IAEA Nudat database

Energy keV	ROI channels	Total counts	Estimated Uranophane counts	Corrected counts	Efficiency	% yield	time (m)	Sample wt (g)	Activity (dpm)	Activity (dpm/g)	Activity (Bq/g)	ppb	ppm	molality	moles
29.37	Genie	47600	0	47600	0.1356	0.1412	120	0.1039	20717.21	199396	3353.473	128530.991	128.531	0.000542	5.63E-08
57.1	Genie	1940	0	1940	0.2258	0.0035	120	0.1039	20225.22	194660	3273.8349	125478.645	125.4786	0.000529	5.5E-08
86.48	Genie	97300	0	97300	0.3244	0.124	120	0.1039	20157.15	194005	3262.8158	125056.307	125.0563	0.000528	5.48E-08
92.28	Genie	84500	74705.6377	9794.362	0.1977	0.0166	120	0.1039	24870.25	239367	4025.7208	154296.721	154.2967	0.000651	6.76E-08
95.86	Genie	19500	340.00236	19160	0.2981	0.0268	120	0.1039	19985.61	192354	3235.0495	123992.087	123.9921	0.000523	5.43E-08
108.43	Genie	8280	0	8280	0.3366	0.0103	120	0.1039	19882.74	191364	3218.3984	123353.89	123.3539	0.00052	5.41E-08
143.25	Genie	4060	1767.83772	2292.162	0.2212	0.0044	120	0.1039	19492.85	187612	3155.2862	120934.942	120.9349	0.00051	5.3E-08
								Average =	20761.58	199823	3360.6541	128806.226	128.8062	0.000543	5.65E-08

Np-237
Abundances (%yield) taken from IAEA Nudat database

Energy keV	ROI channels	Total counts	Estimated Uranophane counts	Corrected counts	Efficiency	% yield	time (m)	Sample wt (g)	Activity (dpm)	Activity (dpm/g)	Activity (Bq/g)	ppb	ppm	molality	moles
29.37	Genie	47000	0	47000	0.1356	0.1412	120	0.1039	20456.07	196882	3311.2023	126910.853	126.9109	0.000535	5.56E-08
57.1	Genie	2070	0	2070	0.2258	0.0035	120	0.1039	21580.52	207705	3493.2156	133887.008	133.887	0.000565	5.87E-08
86.48	Genie	98800	0	98800	0.3244	0.124	120	0.1039	20467.89	196996	3313.1162	126984.205	126.9842	0.000536	5.57E-08
92.28	Genie	83700	74705.6377	8994.362	0.1977	0.0166	120	0.1039	22838.86	219816	3696.9014	141693.82	141.6938	0.000598	6.21E-08
95.86	Genie	19300	340.00236	18960	0.2981	0.0268	120	0.1039	19776.99	190346	3201.2807	122697.806	122.6978	0.000518	5.38E-08
108.43	Genie	7890	0	7890	0.3366	0.0103	120	0.1039	18946.24	182351	3066.8072	117543.743	117.5437	0.000496	5.15E-08
143.25	Genie	4030	1767.83772	2262.162	0.2212	0.0044	120	0.1039	19237.72	185156	3113.9896	119352.136	119.3521	0.000503	5.23E-08
								Average =	20472.04	197036	3313.7876	127009.939	127.0099	0.000536	5.57E-08

Np-237
Abundances (%yield) taken from IAEA Nudat database

Energy keV	ROI channels	Total counts	Estimated Uranophane counts	Corrected counts	Efficiency	% yield	time (m)	Sample wt (g)	Activity (dpm)	Activity (dpm/g)	Activity (Bq/g)	ppb	ppm	molality	moles
29.37	Genie	46900	0	46900	0.1356	0.1412	120	0.1039	20412.55	196463	3304.1572	126640.829	126.6408	0.000534	5.55E-08
57.1	Genie	2150	0	2150	0.2258	0.0035	120	0.1039	22414.55	215732	3628.2191	139061.385	139.0614	0.000587	6.1E-08
86.48	Genie	97900	0	97900	0.3244	0.124	120	0.1039	20281.45	195202	3282.936	125827.466	125.8275	0.000531	5.52E-08
92.28	Genie	83700	74705.6377	8994.362	0.1977	0.0166	120	0.1039	22838.86	219816	3696.9014	141693.82	141.6938	0.000598	6.21E-08
95.86	Genie	19600	340.00236	19260	0.2981	0.0268	120	0.1039	20089.92	193358	3251.9339	124639.228	124.6392	0.000526	5.46E-08
108.43	Genie	8140	0	8140	0.3366	0.0103	120	0.1039	19546.56	188129	3163.9811	121268.196	121.2682	0.000512	5.32E-08
143.25	Genie	3960	1767.83772	2192.162	0.2212	0.0044	120	0.1039	18642.43	179427	3017.6308	115658.922	115.6589	0.000488	5.07E-08
								Average =	20603.76	198304	3335.1085	127827.121	127.8271	0.000539	5.6E-08

Np/Uranophane solid analysis

Sample = Cal-4a
Sample wt (g) = 0.1031

Bq conversion 0.037 Bq per 2.2 dpm = 0.0168 Bq/dpm

Measured Np concentration based on gamma counting

Sample activity = total counts / (counting efficiency * % yield * counting time)

Uranophane reference peak counts

Energy keV	dpm/g
92.28	5991.79
95.86	27.27
143.25	141.79

Np-237
Abundances (%yield) taken from IAEA Nudat database

Energy keV	ROI channels	Total counts	Estimated Uranophane counts	Corrected counts	Efficiency	% yield	time (m)	Sample wt (g)	Activity (dpm)	Activity (dpm/g)	Activity (Bq/g)	ppb	ppm	molality	moles
29.37	Genie	35900	0	35900	0.1356	0.1412	120	0.1031	15624.96	151551	2548.8202	97690.4779	97.69048	0.000412	4.25E-08
57.1	Genie	1590	0	1590	0.2258	0.0035	120	0.1031	16576.34	160779	2704.0148	103638.733	103.6387	0.000437	4.51E-08
86.48	Genie	78500	0	78500	0.3244	0.124	120	0.1031	16262.45	157735	2652.8107	101676.198	101.6762	0.000429	4.42E-08
92.28	Genie	81400	74130.4259	7269.574	0.1977	0.0166	120	0.1031	18459.2	179042	3011.1566	115410.782	115.4108	0.000487	5.02E-08
95.86	Genie	15900	337.38444	15562.62	0.2981	0.0268	120	0.1031	16233.22	157451	2648.0425	101493.444	101.4934	0.000428	4.41E-08
108.43	Genie	6670	0	6670	0.3366	0.0103	120	0.1031	16016.65	155351	2612.7159	100139.456	100.1395	0.000422	4.36E-08
143.25	Genie	3430	1754.22588	1675.774	0.2212	0.0044	120	0.1031	14251	138225	2324.6938	89100.2253	89.10023	0.000376	3.88E-08
								Average =	16203.4	157162	2643.1792	101307.045	101.307	0.000427	4.41E-08

Np-237
Abundances (%yield) taken from IAEA Nudat database

Energy keV	ROI channels	Total counts	Estimated Uranophane counts	Corrected counts	Efficiency	% yield	time (m)	Sample wt (g)	Activity (dpm)	Activity (dpm/g)	Activity (Bq/g)	ppb	ppm	molality	moles
29.37	Genie	35700	0	35700	0.1356	0.1412	120	0.1031	15537.91	150707	2534.6206	97146.2413	97.14624	0.00041	4.23E-08
57.1	Genie	1500	0	1500	0.2258	0.0035	120	0.1031	15638.06	151679	2550.9573	97772.39	97.77239	0.000412	4.25E-08
86.48	Genie	78400	0	78400	0.3244	0.124	120	0.1031	16241.73	157534	2649.4313	101546.674	101.5467	0.000428	4.42E-08
92.28	Genie	80300	74130.4259	6169.574	0.1977	0.0166	120	0.1031	15666.04	151950	2555.5216	97947.3298	97.94733	0.000413	4.26E-08
95.86	Genie	15900	337.38444	15562.62	0.2981	0.0268	120	0.1031	16233.22	157451	2648.0425	101493.444	101.4934	0.000428	4.41E-08
108.43	Genie	6320	0	6320	0.3366	0.0103	120	0.1031	15176.2	147199	2475.6169	94884.7622	94.88476	0.0004	4.13E-08
143.25	Genie	3430	1754.22588	1675.774	0.2212	0.0044	120	0.1031	14251	138225	2324.6938	89100.2253	89.10023	0.000376	3.88E-08
								Average =	15534.88	150678	2534.1263	97127.2953	97.1273	0.00041	4.22E-08

Np-237
Abundances (%yield) taken from IAEA Nudat database

Energy keV	ROI channels	Total counts	Estimated Uranophane counts	Corrected counts	Efficiency	% yield	time (m)	Sample wt (g)	Activity (dpm)	Activity (dpm/g)	Activity (Bq/g)	ppb	ppm	molality	moles
29.37	Genie	36000	0	36000	0.1356	0.1412	120	0.1031	15668.48	151974	2555.9199	97962.5963	97.9626	0.000413	4.26E-08
57.1	Genie	1490	0	1490	0.2258	0.0035	120	0.1031	15533.8	150667	2533.9509	97120.5741	97.12057	0.00041	4.22E-08
86.48	Genie	77800	0	77800	0.3244	0.124	120	0.1031	16117.43	156328	2629.155	100769.531	100.7695	0.000425	4.38E-08
92.28	Genie	80900	74130.4259	6769.574	0.1977	0.0166	120	0.1031	17189.58	166727	2804.0498	107472.849	107.4728	0.000453	4.67E-08
95.86	Genie	15600	337.38444	15262.62	0.2981	0.0268	120	0.1031	15920.29	154416	2596.9963	99536.9587	99.53696	0.00042	4.33E-08
108.43	Genie	6660	0	6660	0.3366	0.0103	120	0.1031	15992.64	155118	2608.7988	99989.3222	99.98932	0.000422	4.35E-08
143.25	Genie	3800	1754.22588	2045.774	0.2212	0.0044	120	0.1031	17397.53	168744	2837.9711	108772.974	108.773	0.000459	4.73E-08
								Average =	16259.97	157711	2652.408	101660.687	101.6607	0.000429	4.42E-08

11/9/06 JP

Due to an error in calculating the amount of $CaCO_3$ required to adjust pHs to ~6.0 in the procedure To prepare solution for experiment NPuA (see p. 30-33), the pH of these solutions could not be readjusted by addition of acid + base to reach the desired pH of ~6. Therefore, the preparation of these solutions was abandoned and a new procedure to prepare solution for Np-analyte coprecipitate experiment NPuA was initiated.

11/9/06 JP

A revised procedure for preparation of solutions for a Np-analyte coprecipitate test entitled "NPuA" is shown on the following pages.

11/9/06 JP

Preparation of solutions for Np-uranophane coprecipitation experiment NPUA

Written by: J. D. Prikryl
Date: 11/09/06

Objective: Prepare solutions containing U, Np, Ca, Na, and SiO_2 for use in Np-uranophane coprecipitation tests. Solutions will have a Ca content of 10^{-2} M and a SiO_2 content of 10^{-3} M. U contents will be 1.0 x 10^{-5} M (2.38 ppm). Np contents will be 4.33 x 10^{-7} M (0.1 ppm), 1.08 x 10^{-6} M (0.25 ppm) or 2.16 x 10^{-6} M (0.5 ppm). Solutions will have Na contents of 0.0 ppm and 4.35 x10^{-4} M (10 ppm). The pH of the solutions will be approximately 6.0.

Method: Addition of chemical reagents containing Ca, Np, Na, and U to an approximate 10^{-3} M SiO_2 solution.

Materials and Equipment:

- Previously prepared 10^{-3} M SiO_2 solution (scientific notebook 325, p. 73-74)
- Np standard solution #61A (102.55 ppm Np; 4.33 x 10^{-4} M Np, see scientific notebook 582, p. 177)
- $CaCl_2 \cdot 2H_2O$; F.W. 147.02; (lot no. 061720)
- $UO_2(NO_3)_2 \cdot 6H_2O$; F.W. 502.13; (lot no. 8640 ICCAT)
- $CaCO_3$; F.W. 100.09; (lot no. 926356)
- NaCl; F.W. 58.44; (lot no. 984321)
- Polypropylene bottles; various volumes
- 30 ml LDPE bottles
- Orion pH meter
- Orion combination pH electrode
- ATC probe
- pH buffer solutions
- Mettler analytical balances (AE240 and PR5002)
- weighing paper and boats
- Gyratory shaker

Procedure
11/9/06 JP

1. Transfer 100 g of the previously prepared 10^{-3} M SiO_2 solution to a 250 ml polypropylene bottle. Add 0.0502 g of $UO_2(NO_3)_2 \cdot 6H_2O$ to the bottle. Label the bottle as 10^{-3} m U.

11/9/06 JP

2. Label 8 250 ml polypropylene bottles as follows:

   0.0 ppm Np
   0.1 ppm Np
   0.25 ppm Np
   0.5 ppm Np
   0.0 ppm Np/10.0 ppm Na
   0.1 ppm Np/10.0 ppm Na
   0.25 ppm Np/10.0 ppm Na
   0.5 ppm Np/10.0 ppm Na

11/9/06 JP

3. Transfer about 50 g of the previously prepared 1x10^{-3} M SiO_2 solution into the 8 bottles listed above.

4. Carefully add the following quantities of chemicals and reagents listed below to the specified bottle. Use weighing paper and weigh out reagents as accurately as possible. After adding reagents make up to a final weight of 200 g with the 10^{-3} M SiO_2 solution.

11/9/06 gf

Bottle Label	$CaCl_2 \cdot 2H_2O$	$CaCO_3$	1000 ppm Na soln	10^{-3} M U soln	4.33×10^{-4} M Np soln
0.0 ppm Np	0.2940 g	0.0002 g	0 g	2.0 g	0 g
0.1 ppm Np	0.2940 g	0.0009 g	0 g	2.0 g	0.2 g
0.25 ppm Np	0.2940 g	0.002 g	0 g	2.0 g	0.5 g
0.5 ppm Np	0.2940 g	0.0037 g	0 g	2.0 g	1.0 g
0.0 ppm Np/10 ppm Na	0.2940 g	0.0002 g	2.0 g	2.0 g	0 g
0.1 ppm Np/10 ppm Na	0.2940 g	0.0009 g	2.0 g	2.0 g	0.2 g
0.25 ppm Np/10 ppm Na	0.2940 g	0.002 g	2.0 g	2.0 g	0.5 g
0.5 ppm Np/10 ppm Na	0.2940 g	0.0037 g	2.0 g	2.0 g	1.0 g

11/9/06 gf

5. Allow solutions to equilibrate with air by loosely capping bottles and placing on a gryratory shaker.

11/9/06 gf

6. Every 3 or 4 days measure and record pH to determine when solutions reach equilibrium with air. Note: the pH of the solutions may have to be adjusted to reach the desired pH of about 6 by addition of acid (HNO_3) or base ($CaCO_3$).

11/28/06 gf

7. When equilibrium is reached (i.e., when pH is stable) record the weight of each solution bottle.

250 ml PP Bottle w/o cap	Wt (g)
0.0 ppm Np	231.52
0.1 ppm Np	231.25
0.25 ppm Np	231.31
0.5 ppm Np	231.87
0.0 ppm Np/10 ppm Na	232.73
0.1 ppm Np/10 ppm Na	231.97
0.25 ppm Np/10 ppm Na	230.96
0.5 ppm Np/10 ppm Na	231.70

gf 11/3/06 *Note pHs recorded on p48.

11/28/06 gf

8. Label and weight 8 30 ml LDPE bottles as below. Take a ~28 g sample aliqout from each solution and place in corresponding 30 ml LDPE bottle for gamma counting. Weight bottles and record. Gamma counting will show the initial Np contents of the solutions before addition of uranophane.

30 ml LDPE Bottle	Wt of bottle (g) with cap	Wt of bottle + sample (g)	Wt of sample (g)
0.0 ppm Np	11.34	39.79	28.45
0.1 ppm Np	11.32	39.70	28.38
0.25 ppm Np	11.29	39.74	28.45
0.5 ppm Np	11.28	39.72	28.44
0.0 ppm Np/10 ppm Na	11.32	39.67	28.35
0.1 ppm Np/10 ppm Na	11.34 gf 11/28/06	39.72	28.38
0.25 ppm Np/10 ppm Na	11.34	39.70	28.36
0.5 ppm Np/10 ppm Na	11.28	39.64	28.36

9. After sampling record the weight of each 250 ml solution bottle.

11/28/06 JP

250 ml PP Bottle	Wt (g)
0.0 ppm Np	203.05
0.1 ppm Np	202.81
0.25 ppm Np	202.87
0.5 ppm Np	203.44
0.0 ppm Np/10 ppm Na	204.35
0.1 ppm Np/10 ppm Na	203.59
0.25 ppm Np/10 ppm Na	202.59
0.5 ppm Np/10 ppm Na	203.33

10. After measuring the Np contents of the 28 g sample aliqouts by gamma counting (# 8 above), acidify each sample by addition of HNO_3. Take two 10 ml sample aliqouts from each sample solution and place in 15 ml polypropylene bottles for cation analysis by ICP. Use an Oxford pipettor and 10 ml plastic tips to take samples. Chemical analysis will show the initial Ca, SiO_2, Na, and U contents of solutions before addition of uranophane. Label samples as shown below.

10 ml PP Bottle	Label
0.0 ppm Np	NPUA-M1; NPUA-M2
0.1 ppm Np	NPUA-M3; NPUA-M4
0.25 ppm Np	NPUA-M5; NPUA-M6
0.5 ppm Np	NPUA-M7; NPUA-M8
0.0 ppm Np/10 ppm Na	NPUA-M9; NPUA-M10
0.1 ppm Np/10 ppm Na	NPUA-M11; NPUA-M12
0.25 ppm Np/10 ppm Na	NPUA-M13; NPUA-M14
0.5 ppm Np/10 ppm Na	NPUA-M15; NPUA-M16

11/9/06

11/13/06 gp

pH measurment of NPuA Solutions

Sample	11/13/06 gp	11/14/06 gp	11/16/06 gp	11/27/06 gp	11/28/06 gp
0.0 ppm Np	6.16	6.22	6.21	6.09	6.14
0.1 ppm Np	4.74 add .0003 g $CaCO_3$	5.27 add .0002 g $CaCO_3$	6.16	6.07	6.07
0.25 ppm Np	5.50 add .0001 g $CaCO_3$	6.03	6.10	5.99	5.95
0.5 ppm Np	6.81	6.87 0.8 µl 0.1N HNO_3	6.44 0.4 µl 0.1N HNO_3	5.97 5.97	5.93
0.0 ppm Np / 10 ppm Na	6.09	6.12	6.12	6.05	6.08
0.1 ppm Np / 10 ppm Na	6.44	6.49 0.3 µl 0.1N HNO_3	6.25 0.2 µl 0.1N HNO_3	5.91	5.91
0.25 ppm Np / 10 ppm Na	6.75	6.83 0.7 µl 0.1N HNO_3	6.41 0.3 µl 0.1N HNO_3	5.97	6.00
0.5 ppm Np / 10 ppm Na	6.48	6.55 0.3 µl 0.1N HNO_3	6.31 0.3 µl 0.1N HNO_3	5.83	5.81

Np-Uranophane coprecipitation test NPUA

Written by: J. D. Prikryl
Date: 11/27/06

Objective: Precipitate uranophane from solutions containing Np to evaluate incorporation of Np into the uranophane.

Method: Evaluate incorporation of Np into synthesized uranophane from solutions containing Np and considered to be supersaturated with uranophane. Np incorporation will be determined by tracking Np in solution and in the solid (i.e., the uranophane) by gamma spectrometry analysis.

Materials and Equipment:

- Synthesized uranophane (URANOPHANE-7)
- Previously prepared $CaCl_2$-SiO_2 test solutions containing Np, U, Na
- Polypropylene bottles (250 ml and 15 ml)
- 30 ml LDPE bottles
- Orion pH meter
- Orion combination pH electrode
- ATC probe
- pH buffer solutions (Fisher certified)
- gyratory shaker
- Mettler analytical balance (AE240 and PR5002)
- Pipets and pipet tips
- Plasticware as needed
- IEC EXD Centrifuge
- 25 mm membrane filters
- Filtration system for 25 mm membrane filters
- 100 mm x 15 mm polystyrene petri dishes

Procedure

1. Label 8 250 ml polypropylene bottles as follows and record weights.

11/28/06 JP

Label	Weight (g)
NPUA-1	28.57
NPUA-2	28.58
NPUA-3	28.53
NPUA-4	28.53
NPUA-5	28.58
NPUA-6	28.62
NPUA-7	28.52
NPUA-8	28.55

wt + cap

2. To each sample bottle add 0.1±0.0010 g of synthesized uranophane. Record the weight of uranophane added to each bottle.

11/28/01 JP 9:10

Bottle	Wt of uranophane (g)
NPUA-1	0.1000
NPUA-2	0.1003
NPUA-3	0.1009
NPUA-4	0.0996
NPUA-5	0.0999
NPUA-6	0.1000
NPUA-7	0.1006
NPUA-8	0.1005

3. To each bottle add 150±0.05 g of the specified test solution shown in the table below. Record the weight of matrix solution added.

11/28/01 JP 9:30

Bottle	Test solution	Wt of test solution (g)
NPUA-1	0.0 ppm Np	150.54
NPUA-2	0.1 ppm Np	150.30
NPUA-3	0.25 ppm Np	151.66
NPUA-4	0.5 ppm Np	150.69
NPUA-5	0.0 ppm Np/10.0 ppm Na	150.94
NPUA-6	0.1 ppm Np/10.0 ppm Na	150.28
NPUA-7	0.25 ppm Np/10.0 ppm Na	151.61
NPUA-8	0.5 ppm Np/10.0 ppm Na	151.44

4. Record the initial sample weights (bottle + synthesized uranophane + U/Np matrix solution).

11/28/01 JP

Sample	Initial wt (g)
NPUA-1	179.21
NPUA-2	178.98
NPUA-3	180.30
NPUA-4	179.29
NPUA-5	179.64
NPUA-6	179.00
NPUA-7	180.23
NPUA-8	180.09

w/o cap

5. Loosely cap the bottles and place on a gryratory shaker set at about 120 rpm.

6. At 48 hrs, approximately 1 week, and approximately 3 weeks:

Note: 30ml sample bottles shall be weighed before and after ~28ml solute transfer. See #8.

- Remove sample bottles from gyratory shaker
- Record the weight of each sample bottle
- Centrifuge to remove suspended solids from the solution column
- For each sample bottle
  - ensure that solids in the bottle have not been resuspended during sample handling
  - remove a 28 ml aliqout and transfer to a 30 ml LDPE bottle for gamma counting of Np
  - remove a 5 ml aliqout using a pipettor with a 5 ml tip, transfer to a 15 ml PP bottle, and preserve for cation analysis by adding 10 µl of 6 M HNO_3 to the 15 ml PP bottle. After several minutes draw the acidified sample up into the 5 ml tip used to take the sample, wait a few minutes, and expel the sample back into the 15 ml PP bottle. Discard 5 ml tip

Note * →

- remove a second 5 ml aliqout using a pipettor with a 5 ml tip, transfer to a 10 ml sample cup, and use to measure pH. ~~Discard sample and 5 ml tip after~~ After pH measurement transfer solution back to bottle
- record the weight of the bottle
- loosely cap bottle and place back on gyratory shaker JP 11/30/06

- Below are tables into which data can be recorded. Samples for cation analyses should be labeled as shown in the tables.

NPUA-1

Date / Time	Wt of bottle before sampling	Wt of bottle after sampling	Wt of solution removed	pH of solution removed	Sample Label
11/30/06 0930	~~180.0~~ 178.97	145.45	33.52	6.02	NPUA-1A
12/06/06 1335	144.33	110.64	33.69	5.89	NPUA-1B
12/19/06 0805	108.68	76.74	31.94	5.74	NPUA-1C

NPUA-2

Date / Time	Wt of bottle before sampling	Wt of bottle after sampling	Wt of solution removed	pH of solution removed	Sample Label Cations
11/30/06 0930	178.79	144.68	34.11	6.37	NPUA-2A
12/06/06 1340	143.45	109.81	33.64	6.24	NPUA-2B
12/19/06 0805	107.47	74.27	33.20	6.16	NPUA-2C

NPUA-3

Date / Time	Wt of bottle before sampling	Wt of bottle after sampling	Wt of solution removed	pH of solution removed	Sample Label Cations
11/30/06 0920	180.05	145.89	34.16	5.77	NPUA-3A
12/06/06 1323	144.18	116.52	33.66	5.63	NPUA-3B
12/19/06 0835	108.57	74.70	33.87	5.48	NPUA-3C

NPUA-4

Date / Time	Wt of bottle before sampling	Wt of bottle after sampling	Wt of solution removed	pH of solution removed	Sample Label Cations
11/30/06 0920	179.11	146.64	32.47	5.74	NPUA-4A
12/06/06 1317	145.38	111.82	33.56	5.66	NPUA-4B
12/19/06 0827	109.86	76.45	33.41	5.45	NPUA-4C

NPUA-5

Date / Time	Wt of bottle before sampling	Wt of bottle after sampling	Wt of solution removed	pH of solution removed	Sample Label Cations
11/30/06 0930	179.41	145.22	34.19	6.09	NPUA-5A
12/06/06 1337	144.18	110.47	33.71	6.00	NPUA-5B
12/19/06 0830	108.22	74.44	33.78	5.85	NPUA-5C

NPUA-6

Date / Time	Wt of bottle before sampling	Wt of bottle after sampling	Wt of solution removed	pH of solution removed	Sample Label Cations
11/30/06 0920	178.77	144.76	34.01	5.68	NPUA-6A
12/06/06 1320	143.68	110.51	33.17	5.53	NPUA-6B
12/19/06 0810	108.87	75.63	33.24	5.39	NPUA-6C

NPUA-7

Date / Time	Wt of bottle before sampling	Wt of bottle after sampling	Wt of solution removed	pH of solution removed	Sample Label Cations
11/30/06 0920	180.07	146.04	34.03	5.91	NPUA-7A
12/06/06 1315	145.02	112.16	32.86	5.74	NPUA-7B
12/19/06 0833	110.69	76.95	33.74	5.60	NPUA-7C

NPUA-8

Date / Time	Wt of bottle before sampling	Wt of bottle after sampling	Wt of solution removed	pH of solution removed	Sample Label Cations
11/30/06 0930	179.87	145.62	34.25	5.83	NPUA-8A
12/06/06 1342	144.69	110.85	33.84	5.62	NPUA-8B
12/19/06 0810	109.31	77.05	32.26	5.56	NPUA-8C

7. After the sampling at approximately 3 weeks, for each sample:

12/22/06 JP

- Label 8 petri dishes as NPUA-1S thru NPUA-8S
- Place a 25 mm membrane filter in each petri dish and record weight in the below table
- Remove solids in sample bottles by filtration; use vacuum filtration system and the associated 25 mm membrane filter for each sample
- After filtration place membrane with solids in its associated petri dish and allow to air dry
- Transfer filtered solution back to the assocated sample bottle
- After drying record weigh of each petri dish and calculate weight of uranophane recovered
- Count uranophane solid by gamma spec to determine Np content

Label	Weight of membrane + petri dish (g)	Weight of membrane + petri dish + uranophane (g)	Weight of uranophane recovered (g)
NPUA-1S	8.1625	8.2523	0.0898
NPUA-2S	8.1677	8.2623	0.0946
NPUA-3S	8.1845	8.2765	0.092
NPUA-4S	8.1507	8.2468	0.0961
NPUA-5S	8.1660	8.2639	0.0979
NPUA-6S	8.1287	8.2331	~~0.044~~ 0.1044
NPUA-7S	8.1777	8.2655	0.0878
NPUA-8S	8.1305	8.2227	0.0922

JP 12/22/06

8. Note from #6

At each sampling time (48 hrs, 1 week, and 3 weeks), 30 ml sample bottles should be weighed before and after transfer of 28 ml aliqout of experimental solution.
Below are tables into which data can be recorded.

Sample Label	Wt of 30 ml sample bottle before solution transfer (g)	Wt of 30 ml sample bottle after solution transfer (g)	Wt of solution Transferred (g)	
NPUA-1A	11.3432	39.9818	28.6386	11/30/06
NPUA-1B	11.3187	40.2140	28.8953	12/6/06
NPUA-1C	11.3141	38.3307	27.0166	12/19/06
NPUA-2A	11.3146	40.4735	29.1589	11/30/06
NPUA-2B	11.4168	40.3056	28.8888	12/6/06
NPUA-2C	11.3246	39.6349	28.3103	12/19/06
NPUA-3A	11.3337	40.4741	29.1404	11/30/06
NPUA-3B	11.3460	40.0926	28.7466	12/6/06
NPUA-3C	11.2938	40.2294	28.9356	12/19/06
NPUA-4A	11.3004	38.9487	27.6483	11/30/06
NPUA-4B	11.3305	40.0478	28.7173	12/6/06
NPUA-4C	11.3018	39.7718	28.4700	12/19/06
NPUA-5A	11.3588	40.5416	29.1828	11/30/06
NPUA-5B	11.3363	40.1143	28.7780	12/6/06
NPUA-5C	11.3649	40.2236	28.8587	12/19/06
NPUA-6A	11.3242	40.3118	28.9876	11/30/06
NPUA-6B	11.3453	39.8565	28.5112	12/6/06
NPUA-6C	11.2901	39.5944	28.3043	12/19/06
NPUA-7A	11.3091	40.2863	28.9772	11/30/06
NPUA-7B	11.3606	39.3909	28.0303	12/6/06
NPUA-7C	11.3184	40.1321	28.8137	12/19/06
NPUA-8A	11.3571	40.6420	29.2849	11/30/06
NPUA-8B	11.3296	40.2075	28.8779	12/6/06
NPUA-8C	11.2971	38.7293	27.4322	12/19/06

4/19/07

6/19/07 JP

Preparation of solutions for Np-uranophane coprecipitation experiment NPUB

Written by: J. D. Prikryl
Date: 06/19/07

Objective: Prepare solutions containing U, Np, Ca, Na, and Si for use in Np-uranophane coprecipitation test. Solutions will have a Ca content of 10^{-2} M (~400 ppm Ca) and a Si content of 4 x 10^{-3} M (~128 ppm Si). U content will be 3.0 x 10^{-4} M (~71 ppm U). Np content will be 8.44 x 10^{-5} M (~20 ppm Np). The pH of the solutions will be approximately 6.0.

Method: Addition of chemical reagents or standards containing Ca, Si, Np, Na, and U to DI water.

Materials and Equipment:

- Np standard solution #61A (102.55 ppm Np; 4.33 x 10^{-4} M Np, see scientific notebook 582, p. 177)
- $CaCl_2 \cdot 2H_2O$; F.W. 147.02; (lot no. 860712A)
- $UO_2(NO_3)_2 \cdot 6H_2O$; F.W. 502.13; (lot no. 3640 KCAP)
- $CaCO_3$; F.W. 100.09; (lot no. 986396)
- $Na_2SiO_3 \cdot 9H_2O$; F.W. 284.20 (lot no. 942853A)
- Polypropylene bottles; various volumes
- 30 ml LDPE bottles
- Orion pH meter
- Orion combination pH electrode
- ATC probe
- pH buffer solutions
- Mettler analytical balances (AE240 and PR5002)
- weighing paper and boats
- Gyratory shaker

Procedure

JP 6/19/07 1. Transfer 50 g of DI water to a 250 ml polypropylene.

2. Label bottle NPUB.

JP 6/19/07 3. Carefully add the following quantities of standards and reagents listed below to the specified bottle. Use weighing paper and weigh out reagents as accurately as possible. After adding reagents make up to a final weight of 150 g with DI water.

Bottle Label	$CaCl_2 \cdot 2H_2O$	$CaCO_3$	Uranyl nitrate	Sodium silicate	Np standard Solution #61A
NPUB	0.2205 g	0.05 g	0.02259 g	0.17052 g	30 g

4. Allow solutions to equilibrate with air by loosely capping bottles and placing on a gryratory shaker.

5. Every 3 or 4 days measure and record pH to determine when solutions reach equilibrium with air. Note: the pH of the solutions may have to be adjusted to reach the desired pH of about 6 by addition of acid (HNO_3) or base ($CaCO_3$).

6/19/07 gp

*Note- pHs of solution NPuB are recorded below.

Date	pH
6/22/07	5.80
6/25/07	5.93
6/26/07	5.96
6/28/07	5.96

* Note
6/21/07 - A precipitate was noticed in solution bottle NPuB.

6/25/07 - The precipitate was removed from NPuB by filtering through a 25 mm membrane filter. After drying the precipitate was analyzed by gamma spectrometry and was found to contain Np. No U was observed in the gamma spectrum. It is assumed that the precipitate is either a Np carbonate or Np Nitrate precipated due to an increase in pH to ~6.0.

6/29/07 JP

6. When equilibrium is reached (i.e., when pH is stable) record the weight of the bottle.

6/29/07 JP

	Wt (g)
NPUB	179.18

7. Label and weight 1 30 ml LDPE bottles as below. Take a ~28 g sample aliqout from NPUB solution and place in the 30 ml LDPE bottle for gamma counting. Weight bottle and record. Gamma counting will show the initial Np content of the solution before addition of uranophane.

6/29/07 JP

30 ml LDPE Bottle	Wt of bottle (g)	Wt of bottle + sample (g)	Wt of sample (g)
NPUB-initial	11.2833	39.9426	28.6593

8. After sampling record the weight of NPUB bottle.

6/29/07 JP

	Wt (g)
NPUB	150.51

9. After measuring the Np content of the 28 g sample aliqout by gamma counting (# 7 above), acidify the sample by addition of HNO_3. Take two 10 ml sample aliqouts and place in 15 ml polypropylene bottles for cation analysis by ICP. Use an Oxford pipettor and 10 ml plastic tips to take samples. Chemical analysis will show the initial Ca, SiO_2, Na, and U contents of solutions before addition of uranophane. Label samples as NPUB-M1 and NPUB-M2.

6/29/07 JP

6/29/07 JP

Np-Uranophane coprecipitation test NPUB

Written by: J. D. Prikryl
Date: 06/28/07

Objective: Precipitate uranophane from solutions containing Np to evaluate incorporation of Np into the uranophane.

Method: Evaluate incorporation of Np into synthesized uranophane from solutions containing Np and considered to be supersaturated with uranophane. Np incorporation will be determined by tracking Np in solution and in the solid (i.e., the uranophane) by gamma spectrometry analysis.

Materials and Equipment:

- Synthesized uranophane (URANOPHANE-7)
- Previously prepared NPUB solution
- Polypropylene bottles (15 ml)
- 30 ml LDPE bottles
- Orion pH meter
- Orion combination pH electrode
- ATC probe
- pH buffer solutions (Fisher certified)
- gyratory shaker
- Mettler analytical balance (AE240 and PR5002)
- Pipets and pipet tips
- Plasticware as needed
- IEC EXD Centrifuge
- 25 mm membrane filters
- Filtration system for 25 mm membrane filters
- 100 mm x 15 mm polystyrene petri dishes

Procedure

1. Label 1 250 ml polypropylene bottle as follows and record weight.

6/29/07 JP

Label	Weight (g)
NPUB-1	30.34

2. To bottle NPUB-1 add 0.1±0.0010 g of synthesized uranophane. Record the weight of uranophane added.

6/29/07 JP

Bottle	Wt of uranophane (g)
NPUB-1	0.1008

3. To bottle NPUB-1 add 100±0.05 g of test solution NPUB. Record the weight of solution added.

6/29/07 JP

Bottle	Wt of solution (g)
NPUB-1	101.36

6/29/07 JF

4. Record the initial sample weights (bottle + synthesized uranophane + U/Np solution).

6/29/07 JF

Sample	Initial wt (g)
NPUB-1	131.81

5. Loosely cap the bottle and place on a gryratory shaker set at about 120 rpm.

6. At 48 hrs, approximately 1 week, and approximately 3 weeks:

- Remove sample bottle from gyratory shaker
- Record the weight
- Centrifuge to remove suspended solids from the solution column
- ensure that solids in the bottle have not been resuspended during sample handling
- remove a 28 ml aliqout and transfer to a 30 ml LDPE bottle for gamma counting of Np
- Note: At each sampling time (48 hrs, 1 week, and 3 weeks), 30 ml sample bottle should be weighed before and after transfer of 28 ml aliqout of experimental solution.
- remove a 5 ml aliqout using a pipettor with a 5 ml tip, transfer to a 15 ml PP bottle, and preserve for cation analysis by adding 10 µl of 6 M HNO_3 to the 15 ml PP bottle. After several minutes draw the acidified sample up into the 5 ml tip used to take the sample, wait a few minutes, and expel the sample back into the 15 ml PP bottle. Discard 5 ml tip
- remove a second 5 ml aliqout using a pipettor with a 5 ml tip, transfer to a 10 ml sample cup, and use to measure pH. Discard ~~sample and~~ 5 ml tip after pH measurement. Transfer sample back to 250 ml bottle (NPUB-1).
- record the weight of the bottle
- loosely cap bottle and place back on gyratory shaker
- Below are tables into which data can be recorded. Samples for cation analyses should be labeled as shown in the table.

NPUB-1

Date / Time	Wt of bottle before sampling	Wt of bottle after sampling	Wt of solution removed	pH of solution removed	Sample Label
7/2/07 0900	131.60 g	98.21 g	33.39 g	5.62	NPUB-1A
7/9/07 0735	94.77 g	62.29 g	32.48 g	5.54	NPUB-1B
7/18/07 0955	61.81 g			5.19	NPUB-1C

Sample Label	Wt of 30 ml sample bottle before solution transfer (g)	Wt of 30 ml sample bottle after solution transfer (g)	Wt of solution Transferred (g)
NPUB-1A	11.3323	39.7671	28.4348
NPUB-1B	11.3317	38.8233	27.4916
NPUB-1C	11.3546	37.5511	26.1965

7/18/07

7. After the sampling at approximately 3 weeks, for each sample:

- Label a petri dish as NPUB-1S
- Place a 25 mm membrane filter in the petri dish and record weight in the below table
- Remove solids in sample bottle by filtration; use vacuum filtration system and the associated 25 mm membrane filter
- After filtration place membrane with solids in the petri dish and allow to air dry
- Transfer filtered solution back to sample bottle
- After drying record weigh of petri dish and calculate weight of uranophane recovered
- Count uranophane solid by gamma spec to determine Np content

Label	Weight of membrane + petri dish (g)	Weight of membrane + petri dish + uranophane (g)	Weight of uranophane recovered (g)
NPUB-1S	16.0913	16.1847	0.0934

8/6/07

JP 8/6/07

A summary of initial Np concentrations of NPuA ~~Solutions~~ (see p 45-47) measured by gamma spectrometry are listed on the following page.

Hardcopies of ~~the~~ gamma spectrometry count results for initial Np in the NPuA solutions are kept in a 3-ring binder entitled "NPuA results".

8/6/07 JP

8/6/07 JR

Summary of initial Np concentrations of NPUA solutions measured by gamma spectrometry

Bq conversion 0.037 Bq per 2.2 dpm = 0.0168 Bq/dpm

Measured Np concentration based on gamma counting

Sample activity = total counts / (counting efficiency * % yield * counting time)

Sample = **0.0 ppm Np**
Sample wt (g) = **28.45**

Np-237
Abundances (%yield) taken from IAEA Nudat database

Energy keV	ROI channels	Total counts	Efficiency	% yield	time (m)	Sample wt (g)		Activity (dpm)	Activity (dpm/g)	Activity (Bq/g)	ppb	ppm	molality	moles
29.37	Genie	0	0.1037	0.1412	360	28.45		0	0	0	0	0	0	0
57.1	Genie	0	0.1234	0.00354	360	28.45		0	0	0	0	0	0	0
86.48	Genie	0	0.1396	0.124	360	28.45		0	0	0	0	0	0	0
92.28	Genie	0	0.1324	0.0166	360	28.45		0	0	0	0	0	0	0
95.86	Genie	0	0.1351	0.0268	360	28.45		0	0	0	0	0	0	0
108.43	Genie	0	0.1107	0.01031	360	28.45		0	0	0	0	0	0	0
143.25	Genie	0	0.0935	0.00443	360	28.45		0	0	0	0	0	0	0
							Average =	0	0	0	0	0	0	0

Sample = **0.1 ppm Np**
Sample wt (g) = **28.38**

Np-237
Abundances (%yield) taken from IAEA Nudat database

Energy keV	ROI channels	Total counts	Efficiency	% yield	time (m)	Sample wt (g)		Activity (dpm)	Activity (dpm/g)	Activity (Bq/g)	ppb	ppm	molality	moles
29.37	Genie	23900	0.1037	0.1412	360	28.38		4533.5733	159.7454	2.68663	102.97228	0.1029723	4.34391E-07	1.23E-08
57.1	Genie	612	0.1234	0.00354	360	28.38		3892.6262	137.1609	2.3068	88.414276	0.0884143	3.72977E-07	1.06E-08
86.48	Genie	29200	0.1396	0.124	360	28.38		4684.8703	165.0765	2.77629	106.40873	0.1064087	4.48887E-07	1.27E-08
92.28	Genie	3690	0.1324	0.0166	360	28.38		4663.6044	164.3271	2.76368	105.92571	0.1059257	4.4685E-07	1.27E-08
95.86	Genie	6080	0.1351	0.0268	360	28.38		4666.0977	164.415	2.76516	105.98234	0.1059823	4.47089E-07	1.27E-08
108.43	Genie	1880	0.1107	0.01031	360	28.38		4574.0733	161.1724	2.71063	103.89217	0.1038922	4.38271E-07	1.24E-08
143.25	Genie	842	0.0935	0.00443	360	28.38		5648.8808	199.0444	3.34757	128.30456	0.1283046	5.41255E-07	1.54E-08
							Average =	4666.2466	164.4202	2.76525	105.98573	0.1059857	4.47103E-07	1.27E-08

Sample = **0.25 ppm Np**
Sample wt (g) = **28.45**

Np-237
Abundances (%yield) taken from IAEA Nudat database

Energy keV	ROI channels	Total counts	Efficiency	% yield	time (m)	Sample wt (g)	Activity (dpm)	Activity (dpm/g)	Activity (Bq/g)	ppb	ppm	molality	moles
29.37	Genie	59900	0.1037	0.1412	360	28.45	11362.387	399.3809	6.71686	257.44198	0.257442	1.08602E-06	3.09E-08
57.1	Genie	1610	0.1234	0.00354	360	28.45	10240.406	359.944	6.0536	232.02083	0.2320208	9.78784E-07	2.78E-08
86.48	Genie	73600	0.1396	0.124	360	28.45	11808.44	415.0594	6.98054	267.54839	0.2675484	1.12866E-06	3.21E-08
92.28	Genie	9190	0.1324	0.0166	360	28.45	11614.776	408.2522	6.86606	263.16047	0.2631605	1.11015E-06	3.16E-08
95.86	Genie	15200	0.1351	0.0268	360	28.45	11665.244	410.0262	6.89589	264.30395	0.2643039	1.11497E-06	3.17E-08
108.43	Genie	4700	0.1107	0.01031	360	28.45	11435.183	401.9397	6.75989	259.09137	0.2590914	1.09298E-06	3.11E-08
143.25	Genie	1720	0.0935	0.00443	360	28.45	11539.281	405.5986	6.82143	261.44996	0.26145	1.10293E-06	3.14E-08
						Average =	11380.817	400.0287	6.72776	257.85956	0.2578596	1.08779E-06	3.09E-08

Sample = **0.5 ppm Np**
Sample wt (g) = **28.44**

Np-237
Abundances (%yield) taken from IAEA Nudat database

Energy keV	ROI channels	Total counts	Efficiency	% yield	time (m)	Sample wt (g)	Activity (dpm)	Activity (dpm/g)	Activity (Bq/g)	ppb	ppm	molality	moles
29.37	Genie	119000	0.1037	0.1412	360	28.44	22573.022	793.7068	13.3487	511.62551	0.5116255	2.1583E-06	6.14E-08
57.1	Genie	3200	0.1234	0.00354	360	28.44	20353.601	715.6681	12.0362	461.32156	0.4613216	1.94609E-06	5.53E-08
86.48	Genie	146000	0.1396	0.124	360	28.44	23424.352	823.6411	13.8521	530.9212	0.5309212	2.2397E-06	6.37E-08
92.28	Genie	18200	0.1324	0.0166	360	28.44	23002.059	808.7925	13.6024	521.3498	0.5213498	2.19932E-06	6.25E-08
95.86	Genie	30200	0.1351	0.0268	360	28.44	23176.998	814.9437	13.7059	525.31485	0.5253149	2.21605E-06	6.3E-08
108.43	Genie	8820	0.1107	0.01031	360	28.44	21459.216	754.5435	12.69	486.38072	0.4863807	2.05181E-06	5.84E-08
143.25	Genie	3580	0.0935	0.00443	360	28.44	24017.807	844.508	14.2031	544.37207	0.5443721	2.29644E-06	6.53E-08
						Average =	22572.436	793.6862	13.3484	511.61224	0.5116122	2.15825E-06	6.14E-08

Sample = **0.0 ppm Np/10 ppm Na**
Sample wt (g) = **28.35**

Np-237
Abundances (%yield) taken from IAEA Nudat database

Energy keV	ROI channels	Total counts	Efficiency	% yield	time (m)	Sample wt (g)	Activity (dpm)	Activity (dpm/g)	Activity (Bq/g)	ppb	ppm	molality	moles
29.37	Genie	0	0.1037	0.1412	360	28.35	0	0	0	0	0	0	0
57.1	Genie	0	0.1234	0.00354	360	28.35	0	0	0	0	0	0	0
86.48	Genie	0	0.1396	0.124	360	28.35	0	0	0	0	0	0	0
92.28	Genie	0	0.1324	0.0166	360	28.35	0	0	0	0	0	0	0
95.86	Genie	0	0.1351	0.0268	360	28.35	0	0	0	0	0	0	0
108.43	Genie	0	0.1107	0.01031	360	28.35	0	0	0	0	0	0	0
143.25	Genie	0	0.0935	0.00443	360	28.35	0	0	0	0	0	0	0
						Average =	0	0	0	0	0	0	0

Sample = **0.1 ppm Np/10 ppm Na**
Sample wt (g) = **28.38**

Np-237
Abundances (%yield) taken from IAEA Nudat database

Energy keV	ROI channels	Total counts	Efficiency	% yield	time (m)	Sample wt (g)	Activity (dpm)	Activity (dpm/g)	Activity (Bq/g)	ppb	ppm	molality	moles
29.37	Genie	23900	0.1037	0.1412	360	28.38	4533.5733	159.7454	2.68663	102.97228	0.1029723	4.34391E-07	1.23E-08
57.1	Genie	717	0.1234	0.00354	360	28.38	4560.4787	160.6934	2.70257	103.58339	0.1035834	4.36969E-07	1.24E-08
86.48	Genie	29200	0.1396	0.124	360	28.38	4684.8703	165.0765	2.77629	106.40873	0.1064087	4.48887E-07	1.27E-08
92.28	Genie	3630	0.1324	0.0166	360	28.38	4587.7734	161.6552	2.71875	104.20334	0.1042033	4.39584E-07	1.25E-08
95.86	Genie	6000	0.1351	0.0268	360	28.38	4604.7016	162.2516	2.72878	104.58784	0.1045878	4.41206E-07	1.25E-08
108.43	Genie	1860	0.1107	0.01031	360	28.38	4525.413	159.4578	2.68179	102.78693	0.1027869	4.33609E-07	1.23E-08
143.25	Genie	824	0.0935	0.00443	360	28.38	5528.1209	194.7893	3.276	125.56171	0.1255617	5.29684E-07	1.5E-08
						Average =	4717.8473	166.2385	2.79583	107.15775	0.1071577	4.52047E-07	1.28E-08

Sample = **0.25 ppm Np/10 ppm Na**
Sample wt (g) = **28.36**

Np-237
Abundances (%yield) taken from IAEA Nudat database

Energy keV	ROI channels	Total counts	Efficiency	% yield	time (m)	Sample wt (g)	Activity (dpm)	Activity (dpm/g)	Activity (Bq/g)	ppb	ppm	molality	moles
29.37	Genie	59500	0.1037	0.1412	360	28.36	11286.511	397.9729	6.69318	256.53437	0.2565344	1.0822E-06	3.07E-08
57.1	Genie	1900	0.1234	0.00354	360	28.36	12084.951	426.1266	7.16667	274.68234	0.2746823	1.15875E-06	3.29E-08
86.48	Genie	74300	0.1396	0.124	360	28.36	11920.749	420.3367	7.0693	270.95015	0.2709501	1.14301E-06	3.24E-08
92.28	Genie	9020	0.1324	0.0166	360	28.36	11399.922	401.9719	6.76044	259.11212	0.2591121	1.09307E-06	3.1E-08
95.86	Genie	15400	0.1351	0.0268	360	28.36	11818.734	416.7396	7.0088	268.63143	0.2686314	1.13323E-06	3.21E-08
108.43	Genie	1010	0.1107	0.01031	360	28.36	2457.3479	86.64837	1.45727	55.853771	0.0558538	2.3562E-07	6.68E-09
143.25	Genie	1860	0.0935	0.00443	360	28.36	12478.525	440.0044	7.40007	283.62801	0.283628	1.19649E-06	3.39E-08
						Average =	10492.391	369.9715	6.22225	238.4846	0.2384846	1.00605E-06	2.85E-08

Sample = **0.5 ppm Np/10 ppm Na**
Sample wt (g) = **28.36**

Np-237
Abundances (%yield) taken from IAEA Nudat database

Energy keV	ROI channels	Total counts	Efficiency	% yield	time (m)	Sample wt (g)	Activity (dpm)	Activity (dpm/g)	Activity (Bq/g)	ppb	ppm	molality	moles
29.37	Genie	119000	0.1037	0.1412	360	28.36	22573.022	795.9458	13.3864	513.06874	0.5130687	2.16439E-06	6.14E-08
57.1	Genie	3150	0.1234	0.00354	360	28.36	20035.576	706.4731	11.8816	455.39441	0.4553944	1.92109E-06	5.45E-08
86.48	Genie	148000	0.1396	0.124	360	28.36	23745.233	837.279	14.0815	539.71227	0.5397123	2.27679E-06	6.46E-08
92.28	Genie	18100	0.1324	0.0166	360	28.36	22875.674	806.6176	13.5658	519.94782	0.5199478	2.19341E-06	6.22E-08
95.86	Genie	30000	0.1351	0.0268	360	28.36	23023.508	811.8303	13.6535	523.30798	0.523308	2.20758E-06	6.26E-08
108.43	Genie	9070	0.1107	0.01031	360	28.36	22067.471	778.1196	13.0866	501.57793	0.5015779	2.11592E-06	6E-08
143.25	Genie	3720	0.0935	0.00443	360	28.36	24957.051	880.0088	14.8001	567.25602	0.567256	2.39298E-06	6.79E-08
						Average =	22753.934	802.3249	13.4936	517.18074	0.5171807	2.18174E-06	6.19E-08

JP 8/6/07

A summary of Np concentrations of NPUA (Spent Nuclear Fuel) solutions (see p. 49-53) measured by gamma spectrometry are listed in the following pages.

Hardcopies of the gamma spectrometry count results for Np in the NPUA solutions are kept in a 3-ring binder entitled "NPUA Results".

8/6/07 JP

8/6/07 JP

Summary of Np concentrations in NPUA solutions measured by gamma spectrometry

Bq conversion 0.037 Bq per 2.2 dpm = 0.0168 Bq/dpm

Measured Np concentration based on gamma counting

Sample activity = total counts / (counting efficiency * % yield * counting time)

Sample = **NPUA-1A**
Sample wt (g) = **28.6396**

Np-237
Abundances (%yield) taken from IAEA Nudat database

Energy keV	ROI channels	Total counts	Efficiency	% yield	time (m)	Sample wt (g)	Activity (dpm)	Activity (dpm/g)	Activity (Bq/g)	ppb	ppm	molality	moles
29.37	Genie	0	0.1037	0.1412	360	28.639	0	0	0	0	0	0	0
57.1	Genie	0	0.1234	0.00354	360	28.639	0	0	0	0	0	0	0
86.48	Genie	0	0.1396	0.124	360	28.639	0	0	0	0	0	0	0
92.28	Genie	0	0.1324	0.0166	360	28.639	0	0	0	0	0	0	0
95.86	Genie	0	0.1351	0.0268	360	28.639	0	0	0	0	0	0	0
108.43	Genie	0	0.1107	0.01031	360	28.639	0	0	0	0	0	0	0
143.25	Genie	0	0.0935	0.00443	360	28.639	0	0	0	0	0	0	0
						Average =	0	0	0	0	0	0	0

Sample = **NPUA-1B**
Sample wt (g) = **28.8953**

Np-237
Abundances (%yield) taken from IAEA Nudat database

Energy keV	ROI channels	Total counts	Efficiency	% yield	time (m)	Sample wt (g)	Activity (dpm)	Activity (dpm/g)	Activity (Bq/g)	ppb	ppm	molality	moles
29.37	Genie	0	0.1037	0.1412	360	28.895	0	0	0	0	0	0	0
57.1	Genie	0	0.1234	0.00354	360	28.895	0	0	0	0	0	0	0
86.48	Genie	0	0.1396	0.124	360	28.895	0	0	0	0	0	0	0
92.28	Genie	0	0.1324	0.0166	360	28.895	0	0	0	0	0	0	0
95.86	Genie	0	0.1351	0.0268	360	28.895	0	0	0	0	0	0	0
108.43	Genie	0	0.1107	0.01031	360	28.895	0	0	0	0	0	0	0
143.25	Genie	0	0.0935	0.00443	360	28.895	0	0	0	0	0	0	0
						Average =	0	0	0	0	0	0	0

Sample = **NPUA-1C**
Sample wt (g) = **27.0166**

Sample = **NPUA-1C**
Sample wt (g) = **27.0166**

Np-237
Abundances (%yield) taken from IAEA Nudat database

Energy keV	ROI channels	Total counts	Efficiency	% yield	time (m)	Sample wt (g)	Activity (dpm)	Activity (dpm/g)	Activity (Bq/g)	ppb	ppm	molality	moles
29.37	Genie	0	0.1037	0.1412	360	27.017	0	0	0	0	0	0	0
57.1	Genie	0	0.1234	0.00354	360	27.017	0	0	0	0	0	0	0
86.48	Genie	0	0.1396	0.124	360	27.017	0	0	0	0	0	0	0
92.28	Genie	0	0.1324	0.0166	360	27.017	0	0	0	0	0	0	0
95.86	Genie	0	0.1351	0.0268	360	27.017	0	0	0	0	0	0	0
108.43	Genie	0	0.1107	0.01031	360	27.017	0	0	0	0	0	0	0
143.25	Genie	0	0.0935	0.00443	360	27.017	0	0	0	0	0	0	0
						Average =	0	0	0	0	0	0	0

Sample = **NPUA-2A**
Sample wt (g) = **29.1589**

Np-237
Abundances (%yield) taken from IAEA Nudat database

Energy keV	ROI channels	Total counts	Efficiency	% yield	time (m)	Sample wt (g)	Activity (dpm)	Activity (dpm/g)	Activity (Bq/g)	ppb	ppm	molality	moles
29.37	Genie	23700	0.1037	0.1412	360	29.159	4495.6354	154.1771	2.59298	99.382984	0.099383	4.19249E-07	1.22E-08
57.1	Genie	660	0.1234	0.00354	360	29.159	4197.9302	143.9674	2.42127	92.801749	0.0928017	3.91486E-07	1.14E-08
86.48	Genie	29700	0.1396	0.124	360	29.159	4765.0907	163.4181	2.74839	105.33971	0.1053397	4.44378E-07	1.3E-08
92.28	Genie	3630	0.1324	0.0166	360	29.159	4587.7734	157.337	2.64612	101.41984	0.1014198	4.27842E-07	1.25E-08
95.86	Genie	6020	0.1351	0.0268	360	29.159	4620.0506	158.4439	2.66474	102.13338	0.1021334	4.30852E-07	1.26E-08
108.43	Genie	866	0.1107	0.01031	360	29.159	2106.9933	72.25901	1.21527	46.578351	0.0465784	1.96492E-07	5.73E-09
143.25	Genie	772	0.0935	0.00443	360	29.159	5179.2589	177.6219	2.98728	114.49554	0.1144955	4.83002E-07	1.41E-08
						Average =	4278.9618	146.7463	2.46801	94.593078	0.0945931	3.99043E-07	1.16E-08

Sample = **NPUA-2B**
Sample wt (g) = **28.8888**

Np-237
Abundances (%yield) taken from IAEA Nudat database

Energy keV	ROI channels	Total counts	Efficiency	% yield	time (m)	Sample wt (g)	Activity (dpm)	Activity (dpm/g)	Activity (Bq/g)	ppb	ppm	molality	moles
29.37	Genie	24000	0.1037	0.1412	360	28.889	4552.5422	157.5885	2.65035	101.58195	0.101582	4.28525E-07	1.24E-08
57.1	Genie	742	0.1234	0.00354	360	28.889	4719.4913	163.3675	2.74754	105.30713	0.1053071	4.4424E-07	1.28E-08
86.48	Genie	30300	0.1396	0.124	360	28.889	4861.3552	168.2782	2.83013	108.47257	0.1084726	4.57594E-07	1.32E-08
92.28	Genie	3690	0.1324	0.0166	360	28.889	4663.6044	161.433	2.71501	104.06011	0.1040601	4.3898E-07	1.27E-08
95.86	Genie	6150	0.1351	0.0268	360	28.889	4719.8192	163.3789	2.74774	105.31444	0.1053144	4.44271E-07	1.28E-08
108.43	Genie	524	0.1107	0.01031	360	28.889	1274.9013	44.13133	0.74221	28.447175	0.0284472	1.20005E-07	3.47E-09
143.25	Genie	659	0.0935	0.00443	360	28.889	4421.1549	153.0404	2.57386	98.650278	0.0986503	4.16158E-07	1.2E-08
						Average =	4173.2669	144.4597	2.42955	93.119094	0.0931191	3.92825E-07	1.13E-08

3/4/07 JP

88

Sample = **NPUA-2C**
Sample wt (g) = **28.3103**

Np-237
Abundances (%yield) taken from IAEA Nudat database

Energy keV	ROI channels	Total counts	Efficiency	% yield	time (m)	Sample wt (g)	Activity (dpm)	Activity (dpm/g)	Activity (Bq/g)	ppb	ppm	molality	moles
29.37	Genie	23700	0.1037	0.1412	360	28.31	4495.6354	158.7986	2.6707	102.36198	0.102362	4.31816E-07	1.22E-08
57.1	Genie	762	0.1234	0.00354	360	28.31	4846.7013	171.1992	2.87926	110.35547	0.1103555	4.65537E-07	1.32E-08
86.48	Genie	30800	0.1396	0.124	360	28.31	4941.5755	174.5504	2.93562	112.51568	0.1125157	4.7465E-07	1.34E-08
92.28	Genie	3640	0.1324	0.0166	360	28.31	4853.1818	171.4281	2.88311	110.50303	0.110503	4.66159E-07	1.32E-08
95.86	Genie	6040	0.1351	0.0268	360	28.31	4635.3997	163.7354	2.75373	105.5443	0.1055443	4.45241E-07	1.26E-08
108.43	Genie	763	0.1107	0.01031	360	28.31	1856.3925	65.57304	1.10282	42.268557	0.0422686	1.78311E-07	5.05E-09
143.25	Genie	646	0.0935	0.00443	360	28.31	4333.9394	153.087	2.57465	98.680297	0.0986803	4.16285E-07	1.18E-08
						Average =	4280.4037	151.196	2.54284	97.461331	0.0974613	4.11143E-07	1.16E-08

Sample = **NPUA-3A**
Sample wt (g) = **29.1404**

Np-237
Abundances (%yield) taken from IAEA Nudat database

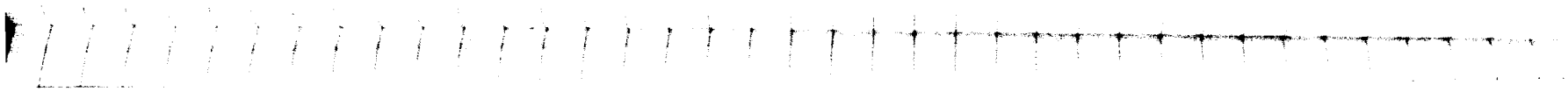
Energy keV	ROI channels	Total counts	Efficiency	% yield	time (m)	Sample wt (g)	Activity (dpm)	Activity (dpm/g)	Activity (Bq/g)	ppb	ppm	molality	moles
29.37	Genie	59900	0.1037	0.1412	360	29.14	11362.387	389.9187	6.55772	251.34262	0.2513426	1.06029E-06	3.09E-08
57.1	Genie	1600	0.1234	0.00354	360	29.14	10176.801	349.2334	5.87347	225.11676	0.2251168	9.49659E-07	2.77E-08
86.48	Genie	75300	0.1396	0.124	360	29.14	12081.19	414.5856	6.97258	267.24296	0.267243	1.12737E-06	3.29E-08
92.28	Genie	9020	0.1324	0.0166	360	29.14	11399.922	391.2068	6.57939	252.17292	0.2521729	1.0638E-06	3.1E-08
95.86	Genie	15500	0.1351	0.0268	360	29.14	11895.479	408.2126	6.86539	263.13494	0.2631349	1.11004E-06	3.23E-08
108.43	Genie	4550	0.1107	0.01031	360	29.14	11070.231	379.8929	6.38911	244.87996	0.24488	1.03303E-06	3.01E-08
143.25	Genie	1790	0.0935	0.00443	360	29.14	12008.903	412.105	6.93086	265.64395	0.2656439	1.12062E-06	3.27E-08
						Average =	11427.845	392.165	6.5955	252.79059	0.2527906	1.0664E-06	3.11E-08

Sample = **NPUA-3B**
Sample wt (g) = **28.7466**

Np-237
Abundances (%yield) taken from IAEA Nudat database

Energy keV	ROI channels	Total counts	Efficiency	% yield	time (m)	Sample wt (g)	Activity (dpm)	Activity (dpm/g)	Activity (Bq/g)	ppb	ppm	molality	moles
29.37	Genie	60000	0.1037	0.1412	360	28.747	11381.355	395.9201	6.65866	255.21112	0.2552111	1.07661E-06	3.09E-08
57.1	Genie	1620	0.1234	0.00354	360	28.747	10304.011	358.4428	6.02836	231.05315	0.2310531	9.74702E-07	2.8E-08
86.48	Genie	74900	0.1396	0.124	360	28.747	12017.013	418.0325	7.03055	269.46486	0.2694649	1.13674E-06	3.27E-08
92.28	Genie	8980	0.1324	0.0166	360	28.747	11349.368	394.8073	6.63994	254.49384	0.2544938	1.07359E-06	3.09E-08
95.86	Genie	15300	0.1351	0.0268	360	28.747	11741.989	408.4653	6.86964	263.29783	0.2632978	1.11073E-06	3.19E-08
108.43	Genie	2030	0.1107	0.01031	360	28.747	4939.026	171.8125	2.88957	110.75081	0.1107508	4.67204E-07	1.34E-08
143.25	Genie	1610	0.0935	0.00443	360	28.747	10801.304	375.742	6.3193	242.20427	0.2422043	1.02174E-06	2.94E-08
						Average =	10362.009	360.4603	6.06229	232.35369	0.2323537	9.80189E-07	2.82E-08

		0.00443	360	28.747		10801.304	375.742	6.3193	242.20427	0.2422043	1.02174E-06	2.94E-08
					Average =	10362.009	360.4603	6.06229	232.35369	0.2323537	9.80189E-07	2.82E-08



Sample = **NPUA-3C**
Sample wt (g) = **28.9356**

Np-237
Abundances (%yield) taken from IAEA Nudat database

Energy keV	ROI channels	Total counts	Efficiency	% yield	time (m)	Sample wt (g)	Activity (dpm)	Activity (dpm/g)	Activity (Bq/g)	ppb	ppm	molality	moles
29.37	Genie	61200	0.1037	0.1412	360	28.936	11608.983	401.2007	6.74747	258.61502	0.258615	1.09097E-06	3.16E-08
57.1	Genie	1770	0.1234	0.00354	360	28.936	11258.086	389.0739	6.54351	250.79804	0.250798	1.058E-06	3.06E-08
86.48	Genie	76700	0.1396	0.124	360	28.936	12305.807	425.2826	7.15248	274.13828	0.2741383	1.15646E-06	3.35E-08
92.28	Genie	9440	0.1324	0.0166	360	28.936	11930.739	412.3204	6.93448	265.78283	0.2657828	1.12121E-06	3.24E-08
95.86	Genie	15800	0.1351	0.0268	360	28.936	12125.714	419.0587	7.04761	270.12633	0.2701263	1.13953E-06	3.3E-08
108.43	Genie	5080	0.1107	0.01031	360	28.936	12359.73	427.1461	7.18382	275.33954	0.2753395	1.16153E-06	3.36E-08
143.25	Genie	2220	0.0935	0.00443	360	28.936	14893.724	514.7197	8.65665	331.78969	0.3317897	1.39966E-06	4.05E-08
						Average =	12354.683	426.9717	7.18089	275.2271	0.2752271	1.16105E-06	3.36E-08

Sample = **NPUA-4A**
Sample wt (g) = **27.6483**

Np-237
Abundances (%yield) taken from IAEA Nudat database

Energy keV	ROI channels	Total counts	Efficiency	% yield	time (m)	Sample wt (g)	Activity (dpm)	Activity (dpm/g)	Activity (Bq/g)	ppb	ppm	molality	moles
29.37	Genie	118000	0.1037	0.1412	360	27.648	22383.332	809.5736	13.6156	521.85325	0.5218533	2.20145E-06	6.09E-08
57.1	Genie	3020	0.1234	0.00354	360	27.648	19208.711	694.752	11.6845	447.83896	0.447839	1.88922E-06	5.22E-08
86.48	Genie	146000	0.1396	0.124	360	27.648	23424.352	847.2257	14.2488	546.12396	0.546124	2.30383E-06	6.37E-08
92.28	Genie	18000	0.1324	0.0166	360	27.648	22749.29	822.8097	13.8382	530.38531	0.5303853	2.23744E-06	6.19E-08
95.86	Genie	29900	0.1351	0.0268	360	27.648	22946.763	829.952	13.9583	534.98928	0.5349893	2.25686E-06	6.24E-08
108.43	Genie	8510	0.1107	0.01031	360	27.648	20704.981	748.8699	12.5946	482.72355	0.4827235	2.03638E-06	5.63E-08
143.25	Genie	3510	0.0935	0.00443	360	27.648	23548.185	851.7046	14.3241	549.01105	0.549011	2.31601E-06	6.4E-08
						Average =	22137.945	800.6982	13.4663	516.13219	0.5161322	2.17731E-06	6.02E-08

Sample = **NPUA-4B**
Sample wt (g) = **28.7173**

Np-237
Abundances (%yield) taken from IAEA Nudat database

Energy keV	ROI channels	Total counts	Efficiency	% yield	time (m)	Sample wt (g)	Activity (dpm)	Activity (dpm/g)	Activity (Bq/g)	ppb	ppm	molality	moles
29.37	Genie	127000	0.1037	0.1412	350	28.717	24778.837	862.854	14.5116	556.19796	0.556198	2.34633E-06	6.74E-08
57.1	Genie	3160	0.1234	0.00354	350	28.717	20673.443	719.8951	12.1073	464.04628	0.4640463	1.95759E-06	5.62E-08
86.48	Genie	144000	0.1396	0.124	350	28.717	23763.569	827.5001	13.917	533.40877	0.5334088	2.2502E-06	6.46E-08
92.28	Genie	18100	0.1324	0.0166	350	28.717	23529.265	819.3411	13.7798	528.14946	0.5281495	2.22801E-06	6.4E-08
95.86	Genie	29600	0.1351	0.0268	350	28.717	23365.572	813.641	13.684	524.47512	0.5244751	2.21251E-06	6.35E-08
108.43	Genie	9300	0.1107	0.01031	350	28.717	23273.552	810.4366	13.6301	522.40961	0.5224096	2.2038E-06	6.33E-08
143.25	Genie	3710	0.0935	0.00443	350	28.717	25601.103	891.4871	14.9932	574.65496	0.574655	2.42419E-06	6.96E-08
						Average =	23569.335	820.7364	13.8033	529.04888	0.5290489	2.2318E-06	6.41E-08

8/6/07 JP

Sample = **NPUA-4C**
Sample wt (g) = **28.47**

Np-237
Abundances (%yield) taken from IAEA Nudat database

Energy keV	ROI channels	Total counts	Efficiency	% yield	time (m)	Sample wt (g)	Activity (dpm)	Activity (dpm/g)	Activity (Bq/g)	ppb	ppm	molality	moles
29.37	Genie	124000	0.1037	0.1412	360	28.47	23521.468	826.1843	13.8949	532.56061	0.5325606	2.24662E-06	6.4E-08
57.1	Genie	3620	0.1234	0.00354	360	28.47	23025.011	808.7464	13.6016	521.3201	0.5213201	2.1992E-06	6.26E-08
86.48	Genie	157000	0.1396	0.124	360	28.47	25189.2	884.7629	14.8801	570.32051	0.5703205	2.40591E-06	6.85E-08
92.28	Genie	18800	0.1324	0.0166	360	28.47	23760.369	834.5757	14.036	537.96968	0.5379697	2.26944E-06	6.46E-08
95.86	Genie	31500	0.1351	0.0268	360	28.47	24174.684	849.1283	14.2808	547.35037	0.5473504	2.30901E-06	6.57E-08
108.43	Genie	2800	0.1107	0.01031	360	28.47	6812.4496	239.2852	4.02434	154.24387	0.1542439	6.50681E-07	1.85E-08
143.25	Genie	5010	0.0935	0.00443	360	28.47	33611.512	1180.594	19.8554	761.01403	0.761014	3.21035E-06	9.14E-08
						Average =	22870.67	803.3253	13.5105	517.82559	0.5178256	2.18446E-06	6.22E-08

Sample = **NPUA-5A**
Sample wt (g) = **29.1828**

Np-237
Abundances (%yield) taken from IAEA Nudat database

Energy keV	ROI channels	Total counts	Efficiency	% yield	time (m)	Sample wt (g)	Activity (dpm)	Activity (dpm/g)	Activity (Bq/g)	ppb	ppm	molality	moles
29.37	Genie	0	0.1037	0.1412	360	29.183	0	0	0	0	0	0	0
57.1	Genie	0	0.1234	0.00354	360	29.183	0	0	0	0	0	0	0
86.48	Genie	0	0.1396	0.124	360	29.183	0	0	0	0	0	0	0
92.28	Genie	0	0.1324	0.0166	360	29.183	0	0	0	0	0	0	0
95.86	Genie	0	0.1351	0.0268	360	29.183	0	0	0	0	0	0	0
108.43	Genie	0	0.1107	0.01031	360	29.183	0	0	0	0	0	0	0
143.25	Genie	0	0.0935	0.00443	360	29.183	0	0	0	0	0	0	0
						Average =	0	0	0	0	0	0	0

Sample = **NPUA-5B**
Sample wt (g) = **28.778**

Np-237
Abundances (%yield) taken from IAEA Nudat database

Energy keV	ROI channels	Total counts	Efficiency	% yield	time (m)	Sample wt (g)	Activity (dpm)	Activity (dpm/g)	Activity (Bq/g)	ppb	ppm	molality	moles
29.37	Genie	0	0.1037	0.1412	360	28.778	0	0	0	0	0	0	0
57.1	Genie	0	0.1234	0.00354	360	28.778	0	0	0	0	0	0	0
86.48	Genie	0	0.1396	0.124	360	28.778	0	0	0	0	0	0	0
92.28	Genie	0	0.1324	0.0166	360	28.778	0	0	0	0	0	0	0
95.86	Genie	0	0.1351	0.0268	360	28.778	0	0	0	0	0	0	0
108 43	Genie	0	0.1107	0.01031	360	28.778	0	0	0	0	0	0	0
143.25	Genie	0	0.0935	0.00443	360	28.778	0	0	0	0	0	0	0
						Average =	0	0	0	0	0	0	0

Average =	0	0	0	0	0	0	0					

Sample = **NPUA-5C**
Sample wt (g) = **28.8587**

Np-237
Abundances (%yield) taken from IAEA Nudat database

Energy keV	ROI channels	Total counts	Efficiency	% yield	time (m)	Sample wt (g)	Activity (dpm)	Activity (dpm/g)	Activity (Bq/g)	ppb	ppm	molality	moles
29.37	Genie	0	0.1037	0.1412	360	28.859	0	0	0	0	0	0	0
57.1	Genie	0	0.1234	0.00354	360	28.859	0	0	0	0	0	0	0
86.48	Genie	0	0.1396	0.124	360	28.859	0	0	0	0	0	0	0
92.28	Genie	0	0.1324	0.0166	360	28.859	0	0	0	0	0	0	0
95.86	Genie	0	0.1351	0.0268	360	28.859	0	0	0	0	0	0	0
108.43	Genie	0	0.1107	0.01031	360	28.859	0	0	0	0	0	0	0
143.25	Genie	0	0.0935	0.00443	360	28.859	0	0	0	0	0	0	0
						Average =	0	0	0	0	0	0	0

Sample = **NPUA-6A**
Sample wt (g) = **28.9876**

Np-237
Abundances (%yield) taken from IAEA Nudat database

Energy keV	ROI channels	Total counts	Efficiency	% yield	time (m)	Sample wt (g)	Activity (dpm)	Activity (dpm/g)	Activity (Bq/g)	ppb	ppm	molality	moles
29.37	Genie	24200	0.1037	0.1412	360	28.988	4590.48	158.3601	2.66333	102.07936	0.1020794	4.30624E-07	1.25E-08
57.1	Genie	499	0.1234	0.00354	360	28.988	3173.8897	109.4913	1.84144	70.578374	0.0705784	2.97736E-07	8.63E-09
86.48	Genie	29400	0.1396	0.124	360	28.988	4716.9585	162.7233	2.73671	104.89188	0.1048919	4.42488E-07	1.28E-08
92.28	Genie	3650	0.1324	0.0166	360	28.988	4613.0504	159.1387	2.67642	102.58126	0.1025813	4.32741E-07	1.25E-08
95.86	Genie	6210	0.1351	0.0268	360	28.988	4765.8662	164.4105	2.76509	105.97945	0.1059795	4.47076E-07	1.3E-08
108.43	Genie	1960	0.1107	0.01031	360	28.988	4768.7147	164.5088	2.76674	106.0428	0.1060428	4.47344E-07	1.3E-08
143.25	Genie	583	0.0935	0.00443	360	28.988	3911.2797	134.9294	2.26927	86.975853	0.0869759	3.66909E-07	1.06E-08
						Average =	4362.8913	150.5089	2.53129	97.018425	0.0970184	4.09274E-07	1.19E-08

Sample = **NPUA-6B**
Sample wt (g) = **28.5112**

Np-237
Abundances (%yield) taken from IAEA Nudat database

Energy keV	ROI channels	Total counts	Efficiency	% yield	time (m)	Sample wt (g)	Activity (dpm)	Activity (dpm/g)	Activity (Bq/g)	ppb	ppm	molality	moles
29.37	Genie	24400	0.1037	0.1412	360	28.511	4628.4179	162.3368	2.73021	104.64275	0.1046428	4.41437E-07	1.26E-08
57.1	Genie	847	0.1234	0.00354	360	28.511	5387.3438	188.9554	3.17789	121.80112	0.1218011	5.1382E-07	1.46E-08
86.48	Genie	29700	0.1396	0.124	360	28.511	4765.0907	167.1305	2.81083	107.73275	0.1077328	4.54473E-07	1.3E-08
92.28	Genie	3710	0.1324	0.0166	360	28.511	4688.8813	164.4575	2.76588	106.00975	0.1060098	4.47204E-07	1.28E-08
95.86	Genie	6260	0.1351	0.0268	360	28.511	4804.2387	168.5036	2.83392	108.61784	0.1086178	4.58206E-07	1.31E-08
108.43	Genie	523	0.1107	0.01031	360	28.511	1272.4683	44.63047	0.7506	28.768919	0.0287689	1.21362E-07	3.46E-09
143.25	Genie	806	0.0935	0.00443	360	28.511	5407.3609	189.6574	3.18969	122.25368	0.1222537	5.1573E-07	1.47E-08
						Average =	4421.9717	155.096	2.60843	99.97526	0.0999753	4.21748E-07	1.2E-08

8/6/07

Sample = **NPUA-6C**
Sample wt (g) = **28.3043**

Np-237
Abundances (%yield) taken from IAEA Nudat database

Energy keV	ROI channels	Total counts	Efficiency	% yield	time (m)	Sample wt (g)	Activity (dpm)	Activity (dpm/g)	Activity (Bq/g)	ppb	ppm	molality	moles
29.37	Genie	24400	0.1037	0.1412	360	28.304	4628.4179	163.5235	2.75017	105.40767	0.1054077	4.44664E-07	1.26E-08
57.1	Genie	646	0.1234	0.00354	360	28.304	4108.8832	145.1682	2.44146	93.575781	0.0935758	3.94751E-07	1.12E-08
86.48	Genie	30000	0.1396	0.124	360	28.304	4813.2229	170.0527	2.85998	109.61643	0.1096164	4.62419E-07	1.31E-08
92.28	Genie	3900	0.1324	0.0166	360	28.304	4929.0127	174.1436	2.92878	112.25343	0.1122534	4.73543E-07	1.34E-08
95.86	Genie	6200	0.1351	0.0268	360	28.304	4758.1917	168.1084	2.82728	108.36314	0.1083631	4.57132E-07	1.29E-08
108.43	Genie	1960	0.1107	0.01031	360	28.304	4768.7147	168.4802	2.83353	108.6028	0.1086028	4.58143E-07	1.3E-08
143.25	Genie	605	0.0935	0.00443	360	28.304	4058.8752	143.4014	2.41175	92.436897	0.0924369	3.89947E-07	1.1E-08
						Average =	4580.7598	161.8397	2.72185	104.32231	0.1043223	4.40086E-07	1.25E-08

Sample = **NPUA-7A**
Sample wt (g) = **28.9772**

Np-237
Abundances (%yield) taken from IAEA Nudat database

Energy keV	ROI channels	Total counts	Efficiency	% yield	time (m)	Sample wt (g)	Activity (dpm)	Activity (dpm/g)	Activity (Bq/g)	ppb	ppm	molality	moles
29.37	Genie	58400	0.1037	0.1412	360	28.977	11077.853	382.2955	6.42951	246.42868	0.2464287	1.03956E-06	3.01E-08
57.1	Genie	1800	0.1234	0.00354	360	28.977	11448.901	395.1003	6.64487	254.6827	0.2546827	1.07438E-06	3.11E-08
86.48	Genie	73300	0.1396	0.124	360	28.977	11760.308	405.8469	6.82561	261.61001	0.26161	1.10361E-06	3.2E-08
92.28	Genie	9650	0.1324	0.0166	360	28.977	12196.147	420.8877	7.07857	271.30532	0.2713053	1.14451E-06	3.32E-08
95.86	Genie	15600	0.1351	0.0268	360	28.977	11972.224	413.1601	6.9486	266.32412	0.2663241	1.12349E-06	3.26E-08
108.43	Genie	-1060	0.1107	0.01031	360	28.977	-2578.9988	-89.00097	-1.49683	-57.37026	-0.0573703	-2.42018E-07	-7.01E-09
143.25	Genie	1800	0.0935	0.00443	360	28.977	12075.992	416.7412	7.00883	268.63246	0.2686325	1.13323E-06	3.28E-08
						Average =	9707.4894	335.0044	5.63416	215.94472	0.2159447	9.10967E-07	2.64E-08

Sample = **NPUA-7B**
Sample wt (g) = **28.0303**

Np-237
Abundances (%yield) taken from IAEA Nudat database

Energy keV	ROI channels	Total counts	Efficiency	% yield	time (m)	Sample wt (g)	Activity (dpm)	Activity (dpm/g)	Activity (Bq/g)	ppb	ppm	molality	moles
29.37	Genie	64500	0.1037	0.1412	360	28.03	12234.957	436.4904	7.34098	281.36287	0.2813629	1.18693E-06	3.33E-08
57.1	Genie	1650	0.1234	0.00354	360	28.03	10494.826	374.41	6.2969	241.3457	0.2413457	1.01812E-06	2.85E-08
86.48	Genie	71900	0.1396	0.124	360	28.03	11535.691	411.5436	6.92142	265.2821	0.2652821	1.1191E-06	3.14E-08
92.28	Genie	9340	0.1324	0.0166	360	28.03	11804.354	421.1283	7.08261	271.46044	0.2714604	1.14516E-06	3.21E-08
95.86	Genie	14700	0.1351	0.0268	360	28.03	11281.519	402.4759	6.76891	259.437	0.259437	1.09444E-06	3.07E-08
108.43	Genie	676	0.1107	0.01031	360	28.03	1644.72	58.6765	0.98683	37.823029	0.037823	1.59557E-07	4.47E-09
143.25	Genie	1950	0.0935	0.00443	360	28.03	13082.325	466.7208	7.8494	300.84948	0.3008495	1.26914E-06	3.56E-08
						Average =	10296.913	367.3494	6.17815	236.79437	0.2367944	9.98922E-07	2.8E-08

Sample = **NPUA-7C**
Sample wt (g) = **28.8137**

Np-237
Abundances (%yield) taken from IAEA Nudat database

Energy keV	ROI channels	Total counts	Efficiency	% yield	time (m)	Sample wt (g)	Activity (dpm)	Activity (dpm/g)	Activity (Bq/g)	ppb	ppm	molality	moles
29.37	Genie	59500	0.1037	0.1412	360	28.814	11286.511	391.7064	6.58779	252.49498	0.252495	1.06515E-06	3.07E-08
57.1	Genie	1820	0.1234	0.00354	360	28.814	11576.111	401.7572	6.75683	258.97374	0.2589737	1.09249E-06	3.15E-08
86.48	Genie	78500	0.1396	0.124	360	28.814	12594.6	437.1046	7.3513	281.75876	0.2817588	1.1886E-06	3.42E-08
92.28	Genie	9670	0.1324	0.0166	360	28.814	12221.424	424.1532	7.13349	273.41029	0.2734103	1.15339E-06	3.32E-08
95.86	Genie	15400	0.1351	0.0268	360	28.814	11818.734	410.1776	6.89844	264.40156	0.2644016	1.11538E-06	3.21E-08
108.43	Genie	4890	0.1107	0.01031	360	28.814	11897.457	412.9097	6.94439	266.16269	0.2661627	1.12281E-06	3.24E-08
143.25	Genie	1670	0.0935	0.00443	360	28.814	11203.837	388.8372	6.53953	250.64546	0.2506455	1.05735E-06	3.05E-08
						Average =	11799.81	409.5208	6.8874	263.97821	0.2639782	1.1136E-06	3.21E-08

Sample = **NPUA-8A**
Sample wt (g) = **29.2849**

Np-237
Abundances (%yield) taken from IAEA Nudat database

Energy keV	ROI channels	Total counts	Efficiency	% yield	time (m)	Sample wt (g)	Activity (dpm)	Activity (dpm/g)	Activity (Bq/g)	ppb	ppm	molality	moles
29.37	Genie	121000	0.1037	0.1412	360	29.285	22952.4	783.7623	13.1815	505.21524	0.5052152	2.13126E-06	6.24E-08
57.1	Genie	3440	0.1234	0.00354	360	29.285	21880.121	747.1469	12.5657	481.61284	0.4816128	2.03169E-06	5.95E-08
86.48	Genie	150000	0.1396	0.124	360	29.285	24066.115	821.7926	13.8211	529.7297	0.5297297	2.23467E-06	6.54E-08
92.28	Genie	18300	0.1324	0.0166	360	29.285	23128.444	789.7737	13.2826	509.09023	0.5090902	2.14761E-06	6.29E-08
95.86	Genie	30700	0.1351	0.0268	360	29.285	23560.723	804.5349	13.5308	518.60531	0.5186053	2.18775E-06	6.41E-08
108.43	Genie	8990	0.1107	0.01031	360	29.285	21872.829	746.8979	12.5615	481.45234	0.4814523	2.03102E-06	5.95E-08
143.25	Genie	3580	0.0935	0.00443	360	29.285	24017.807	820.143	13.7933	528.66637	0.5286664	2.23019E-06	6.53E-08
						Average =	23068.349	787.7216	13.248	507.76743	0.5077674	2.14203E-06	6.27E-08

Sample = **NPUA-8B**
Sample wt (g) = **28.8779**

Np-237
Abundances (%yield) taken from IAEA Nudat database

Energy keV	ROI channels	Total counts	Efficiency	% yield	time (m)	Sample wt (g)	Activity (dpm)	Activity (dpm/g)	Activity (Bq/g)	ppb	ppm	molality	moles
29.37	Genie	131000	0.1037	0.1412	360	28.878	24849.293	860.4951	14.472	554.67745	0.5546774	2.33992E-06	6.76E-08
57.1	Genie	3470	0.1234	0.00354	360	28.878	22070.936	764.2847	12.8539	492.65992	0.4926599	2.0783E-06	6E-08
86.48	Genie	149000	0.1396	0.124	360	28.878	23905.674	827.819	13.9224	533.61431	0.5336143	2.25106E-06	6.5E-08
92.28	Genie	18400	0.1324	0.0166	360	28.878	23254.829	805.2812	13.5434	519.08638	0.5190864	2.18978E-06	6.32E-08
95.86	Genie	30200	0.1351	0.0268	360	28.878	23176.998	802.586	13.498	517.34906	0.5173491	2.18245E-06	6.3E-08
108.43	Genie	9030	0.1107	0.01031	360	28.878	21970.15	760.7946	12.7952	490.4102	0.4904102	2.0688E-06	5.97E-08
143.25	Genie	3420	0.0935	0.00443	360	28.878	22944.385	794.5309	13.3626	512.15675	0.5121567	2.16054E-06	6.24E-08
						Average =	23167.467	802.2559	13.4925	517.13629	0.5171363	2.18155E-06	6.3E-08

8/6/07

Sample = **NPUA-8C**
Sample wt (g) = **27.4322**

Np-237
Abundances (%yield) taken from IAEA Nudat database

Energy keV	ROI channels	Total counts	Efficiency	% yield	time (m)	Sample wt (g)		Activity (dpm)	Activity (dpm/g)	Activity (Bq/g)	ppb	ppm	molality	moles
29.37	Genie	118000	0.1037	0.1412	360	27.432		22383.332	815.9511	13.7228	525.96421	0.5259642	2.21879E-06	6.09E-08
57.1	Genie	2890	0.1234	0.00354	360	27.432		16381.846	670.0828	11.2696	431.93716	0.4319372	1.82214E-06	5E-08
86.48	Genie	152000	0.1396	0.124	360	27.432		24386.996	888.9916	14.9512	573.04636	0.5730464	2.41741E-06	6.63E-08
92.28	Genie	18100	0.1324	0.0166	360	27.432		22875.674	833.8986	14.0247	537.53327	0.5375333	2.26759E-06	6.22E-08
95.86	Genie	30600	0.1351	0.0268	360	27.432		23483.978	856.0735	14.3976	551.82722	0.5518272	2.32789E-06	6.39E-08
108.43	Genie	8870	0.1107	0.01031	360	27.432		21580.867	786.6984	13.2308	507.10785	0.5071079	2.13924E-06	5.87E-08
143.25	Genie	3190	0.0935	0.00443	360	27.432		21401.342	780.154	13.1208	502.88936	0.5028894	2.12145E-06	5.82E-08
							Average =	22070.577	804.55	13.5311	518.61506	0.5186151	2.18779E-06	6E-08

8/6/07 JP

A summary of Np concentrations of NPUA solids recovered in the NPUA experiment (see p 52) measured by gamma spectrometry are listed on the following pages.

Hardcopies of the gamma spectrometry results for Np in the recovered solids are kept in a 3 ring binder entitled "NPUA Results".

8/6/07 JP

3/6/07 JP

Summary of gamma counting of solids recovered in NPUA experiment

Bq conversion 0.037 Bq per 2.2 dpm = 0.0168 Bq/dpm

Measured Np concentration based on gamma counting

Sample activity = total counts / (counting efficiency * % yield * counting time)

Uranophane reference peak counts

Energy keV	dpm/g
92.28	5991.79
95.86	27.27
143.25	141.79

Sample = **NPUA-1S**
Sample wt (g) = **0.0898**

Np-237
Abundances (%yield) taken from IAEA Nudat database

Energy keV	ROI channels	Total counts	Estimated Uranophane counts	Corrected counts	Efficiency	% yield	time (m)	Sample wt (g)	Activity (dpm)	Activity (dpm/g)	Activity (Bq/g)	ppb	ppm	molality	moles
29.37	Genie	0	0	0	0.1356	0.1412	720	0.0898	0	0	0	0	0	0	0
57.1	Genie	0	0	0	0.2258	0.0035	720	0.0898	0	0	0	0	0	0	0
86.48	Genie	541	0	541	0.3244	0.124	720	0.0898	18.67937	208.011	3.4983636	134.084317	0.134084	5.66E-07	5.08E-11
92.28	Genie	410000	387405.174	22594.83	0.1977	0.0166	720	0.0898	9562.286	106484	1790.8716	68640.0339	68.64003	0.00029	2.6E-08
95.86	Genie	1720	1763.16912	-43.16912	0.2981	0.0268	720	0.0898	-7.504883	-83.5733	-1.405551	-53.8715754	-0.053872	-2.27E-07	-2.04E-11
108.43	Genie	0	0	0	0.3366	0.0103	720	0.0898	0	0	0	0	0	0	0
143.25	Genie	9870	9167.57424	702.4258	0.2212	0.0044	720	0.0898	995.5867	11086.7	186.45833	7146.52359	7.146524	3.01E-05	2.71E-09
								Average =	1509.864	16813.6	282.77468	10838.11	10.83811	4.57E-05	4.11E-09

Sample = **NPUA-2S**
Sample wt (g) = **0.0946**

Np-237
Abundances (%yield) taken from IAEA Nudat database

Energy keV	ROI channels	Total counts	Estimated Uranophane counts	Corrected counts	Efficiency	% yield	time (m)	Sample wt (g)	Activity (dpm)	Activity (dpm/g)	Activity (Bq/g)	ppb	ppm	molality	moles
29.37	Genie	3820	0	3820	0.1356	0.1412	720	0.0946	277.1	2929.18	49.263401	1888.15406	1.888154	7.97E-06	7.54E-10
57.1	Genie	0	0	0	0.2258	0.0035	720	0.0946	0	0	0	0	0	0	0
86.48	Genie	7570	0	7570	0.3244	0.124	720	0.0946	261.3731	2762.93	46.467441	1780.99131	1.780991	7.51E-06	7.11E-10
92.28	Genie	406000	408112.8	-2112.8	0.1977	0.0166	720	0.0946	-894.1518	-9451.92	-158.9641	-6092.73347	-6.092733	-2.57E-05	-2.43E-09
95.86	Genie	3120	1857.41424	1262.586	0.2981	0.0268	720	0.0946	219.4985	2320.28	39.022899	1495.65893	1.495659	6.31E-06	5.97E-10
108.43	Genie	0	0	0	0.3366	0.0103	720	0.0946	0	0	0	0	0	0	0
143.25	Genie	10500	9657.60048	842.3995	0.2212	0.0044	720	0.0946	1193.979	12621.3	212.26807	8135.7522	8.135752	3.43E-05	3.25E-09
								Average =	151.1141	1597.4	26.865383	1029.689	1.029689	4.34E-06	4.11E-10

Sample = ***NPUA-3S***
Sample wt (g) = ***0.092***

Np-237
Abundances (%yield) taken from IAEA Nudat database

Energy keV	ROI channels	Total counts	Estimated Uranophane counts	Corrected counts	Efficiency	% yield	time (m)	Sample wt (g)	Activity (dpm)	Activity (dpm/g)	Activity (Bq/g)	ppb	ppm	molality	moles
29.37	Genie	0	0	0	0.1356	0.1412	720	0.092	0	0	0	0	0	0	0
57.1	Genie	0	0	0	0.2258	0.0035	720	0.092	0	0	0	0	0	0	0
86.48	Genie	1840	0	1840	0.3244	0.124	720	0.092	63.53058	690.55	11.613791	445.130192	0.44513	1.88E-06	1.73E-10
92.28	Genie	428000	396896.17	31103.83	0.1977	0.0166	720	0.092	13163.36	143080	2406.3447	92229.7173	92.22972	0.000389	3.58E-08
95.86	Genie	2400	1806.3648	593.6352	0.2981	0.0268	720	0.092	103.2025	1121.77	18.866077	723.093794	0.723094	3.05E-06	2.81E-10
108.43	Genie	0	0	0	0.3366	0.0103	720	0.092	0	0	0	0	0	0	0
143.25	Genie	10600	9392.1696	1207.83	0.2212	0.0044	720	0.092	1711.925	18607.9	312.95063	11994.6855	11.99469	5.06E-05	4.66E-09
								Average =	2148.859	23357.2	392.82503	15056.0895	15.05609	6.35E-05	5.84E-09

Sample = **NPUA-4S**
Sample wt (g) = **0.0961**

Np-237
Abundances (%yield) taken from IAEA Nudat database

Energy keV	ROI channels	Total counts	Estimated Uranophane counts	Corrected counts	Efficiency	% yield	time (m)	Sample wt (g)	Activity (dpm)	Activity (dpm/g)	Activity (Bq/g)	ppb	ppm	molality	moles
29.37	Genie	0	0	0	0.1356	0.1412	720	0.0961	0	0	0	0	0	0	0
57.1	Genie	0	0	0	0.2258	0.0035	720	0.0961	0	0	0	0	0	0	0
86.48	Genie	4510	0	4510	0.3244	0.124	720	0.0961	155.719	1620.38	27.251924	1044.50425	1.044504	4.41E-06	4.23E-10
92.28	Genie	409000	414583.934	-5583.934	0.1977	0.0166	720	0.0961	-2363.159	-24590.6	-413.5696	-15851.1835	-15.85118	-6.69E-05	-6.43E-09
95.86	Genie	0	1886.86584	-1886.866	0.2981	0.0268	720	0.0961	-328.0286	-3413.41	-57.40734	-2200.29267	-2.200293	-9.28E-06	-8.92E-10
108.43	Genie	0	0	0	0.3366	0.0103	720	0.0961	0	0	0	0	0	0	0
143.25	Genie	10200	9810.73368	389.2663	0.2212	0.0044	720	0.0961	551.7286	5741.19	96.556417	3700.78777	3.700788	1.56E-05	1.5E-09
								Average =	-283.3915	-2948.92	-49.59552	-1900.88345	-1.900883	-8.02E-06	-7.71E-10

Sample = **NPUA-5S**
Sample wt (g) = **0.0979**

Np-237
Abundances (%yield) taken from IAEA Nudat database

Energy keV	ROI channels	Total counts	Estimated Uranophane counts	Corrected counts	Efficiency	% yield	time (m)	Sample wt (g)	Activity (dpm)	Activity (dpm/g)	Activity (Bq/g)	ppb	ppm	molality	moles
29.37	Genie	0	0	0	0.1356	0.1412	720	0.0979	0	0	0	0	0	0	0
57.1	Genie	0	0	0	0.2258	0.0035	720	0.0979	0	0	0	0	0	0	0
86.48	Genie	0	0	0	0.3244	0.124	720	0.0979	0	0	0	0	0	0	0
92.28	Genie	406000	422349.294	-16349.29	0.1977	0.0166	720	0.0979	-6919.134	-70675.5	-1188.634	-45557.6306	-45.55763	-0.000192	-1.88E-08
95.86	Genie	2180	1922.20776	257.7922	0.2981	0.0268	720	0.0979	44.81677	457.781	7.6990462	295.086924	0.295087	1.24E-06	1.22E-10
108.43	Genie	0	0	0	0.3366	0.0103	720	0.0979	0	0	0	0	0	0	0
143.25	Genie	10200	9994.49352	205.5065	0.2212	0.0044	720	0.0979	291.2756	2975.24	50.038067	1917.84527	1.917845	8.09E-06	7.92E-10
								Average =	-940.4345	-9606.07	-161.5567	-6192.09977	-6.1921	-2.61E-05	-2.56E-09

8/4/07 JR

Sample = **NPUA-6S**
Sample wt (g) = **0.1044**

Np-237
Abundances (%yield) taken from IAEA Nudat database

Energy keV	ROI channels	Total counts	Estimated Uranophane counts	Corrected counts	Efficiency	% yield	time (m)	Sample wt (g)	Activity (dpm)	Activity (dpm/g)	Activity (Bq/g)	ppb	ppm	molality	moles
29.37	Genie	0	0	0	0.1356	0.1412	720	0.1044	0	0	0	0	0	0	0
57.1	Genie	0	0	0	0.2258	0.0035	720	0.1044	0	0	0	0	0	0	0
86.48	Genie	707	0	707	0.3244	0.124	720	0.1044	24.41093	233.821	3.9324475	150.721765	0.150722	6.36E-07	6.64E-11
92.28	Genie	425000	450390.871	-25390.87	0.1977	0.0166	720	0.1044	-10745.59	-102927	-1731.047	-66347.097	-66.3471	-0.00028	-2.92E-08
95.86	Genie	1900	2049.83136	-149.8314	0.2981	0.0268	720	0.1044	-26.04794	-249.501	-4.19616	-160.829251	-0.160829	-6.78E-07	-7.08E-11
108.43	Genie	0	0	0	0.3366	0.0103	720	0.1044	0	0	0	0	0	0	0
143.25	Genie	10400	10658.0707	-258.0707	0.2212	0.0044	720	0.1044	-365.7778	-3503.62	-58.9245	-2258.44216	-2.258442	-9.53E-06	-9.95E-10
								Average =	-1587.572	-15206.6	-255.7479	-9802.23523	-9.802235	-4.14E-05	-4.32E-09

Sample = **NPUA-7S**
Sample wt (g) = **0.0878**

Np-237
Abundances (%yield) taken from IAEA Nudat database

Energy keV	ROI channels	Total counts	Estimated Uranophane counts	Corrected counts	Efficiency	% yield	time (m)	Sample wt (g)	Activity (dpm)	Activity (dpm/g)	Activity (Bq/g)	ppb	ppm	molality	moles
29.37	Genie	0	0	0	0.1356	0.1412	720	0.0878	0	0	0	0	0	0	0
57.1	Genie	0	0	0	0.2258	0.0035	720	0.0878	0	0	0	0	0	0	0
86.48	Genie	2510	0	2510	0.3244	0.124	720	0.0878	86.66399	987.061	16.600578	636.262404	0.636262	2.68E-06	2.36E-10
92.28	Genie	405000	378776.997	26223	0.1977	0.0166	720	0.0878	11097.76	126398	2125.7868	81476.5712	81.47657	0.000344	3.02E-08
95.86	Genie	0	1723.90032	-1723.9	0.2981	0.0268	720	0.0878	-299.6973	-3413.41	-57.40734	-2200.29267	-2.200293	-9.28E-06	-8.15E-10
108.43	Genie	0	0	0	0.3366	0.0103	720	0.0878	0	0	0	0	0	0	0
143.25	Genie	9580	8963.39664	616.6034	0.2212	0.0044	720	0.0878	873.9459	9953.83	167.40525	6416.26229	6.416262	2.71E-05	2.38E-09
								Average =	1679.81	19132.2	321.76933	12332.6862	12.33269	5.2E-05	4.57E-09

Sample = **NPUA-8S**
Sample wt (g) = **0.0922**

Np-237
Abundances (%yield) taken from IAEA Nudat database

Energy keV	ROI channels	Total counts	Estimated Uranophane counts	Corrected counts	Efficiency	% yield	time (m)	Sample wt (g)	Activity (dpm)	Activity (dpm/g)	Activity (Bq/g)	ppb	ppm	molality	moles
29.37	Genie	0	0	0	0.1356	0.1412	720	0.0922	0	0	0	0	0	0	0
57.1	Genie	0	0	0	0.2258	0.0035	720	0.0922	0	0	0	0	0	0	0
86.48	Genie	4720	0	4720	0.3244	0.124	720	0.0922	162.9697	1767.57	29.727275	1139.3788	1.139379	4.81E-06	4.43E-10
92.28	Genie	413000	397758.987	15241.01	0.1977	0.0166	720	0.0922	6450.102	69957.7	1176.5617	45094.9315	45.09493	0.00019	1.75E-08
95.86	Genie	0	1810.29168	-1810.292	0.2981	0.0268	720	0.0922	-314.7163	-3413.41	-57.40734	-2200.29267	-2.200293	-9.28E-06	-8.56E-10
108.43	Genie	0	0	0	0.3366	0.0103	720	0.0922	0	0	0	0	0	0	0
143.25	Genie	10100	**9412.58736**	**687.4126**	**0.2212**	**0.0044**	720	**0.0922**	**974.3078**	**10567.3**	**177.72327**	6811.72852	6.811729	2.87E-05	2.65E-09
								Average =	**1038.952**	**11268.5**	**189.51498**	7263.67802	7.263678	3.06E-05	2.83E-09

8/6/07 JP

Summary of initial Np concentration in the NPUB solution, Np concentration in NPUB experimental solutions and solids recovered from the NPUB experiments measured by gamma spectrometry are listed in the following pages.

Hardcopies of the gamma spectrometry results for Np in the NPUB experiment are kept in a 3-ring binder entitled "NPUB Results".

8/6/07 JP

8/6/07 JSO

Summary of Np concentrations in NPUB solutions measured by gamma spectrometry

Bq conversion 0.037 Bq per 2.2 dpm = 0.0168 Bq/dpm

Measured Np concentration based on gamma counting

Sample activity = total counts / (counting efficiency * % yield * counting time)

Sample = NPUB-Initial
Sample wt (g) = 28.6593

Np-237
Abundances (%yield) taken from IAEA Nudat database

Energy keV	ROI channels	Total counts	Efficiency	% yield	time (m)	Sample wt (g)	Activity (dpm)	Activity (dpm/g)	Activity (Bq/g)	ppb	ppm	molality	moles
29.37	Genie	296000	0.1037	0.1412	30	28.659	673776.24	23509.86	395.393	15154.52	15.15452	6.39296E-05	1.83E-06
57.1	Genie	8150	0.1234	0.00354	30	28.659	622056.93	21705.24	365.043	13991.254	13.991254	5.90224E-05	1.69E-06
86.48	Genie	320000	0.1396	0.124	30	28.659	616092.54	21497.12	361.543	13857.103	13.857103	5.84565E-05	1.68E-06
92.28	Genie	41400	0.1324	0.0166	30	28.659	627880.39	21908.43	368.46	14122.235	14.122235	5.95749E-05	1.71E-06
95.86	Genie	68200	0.1351	0.0268	30	28.659	628081.3	21915.44	368.578	14126.754	14.126754	5.9594E-05	1.71E-06
108.43	Genie	21600	0.1107	0.01031	30	28.659	630638.19	22004.66	370.078	14184.263	14.184263	5.98366E-05	1.71E-06
143.25	Genie	8750	0.0935	0.00443	30	28.659	704432.88	24579.56	413.383	15844.047	15.844047	6.68384E-05	1.92E-06
						Average =	643279.78	22445.76	377.497	14468.597	14.468597	6.10361E-05	1.75E-06

Sample = NPUB-1A
Sample wt (g) = 28.4348

Np-237
Abundances (%yield) taken from IAEA Nudat database

Energy keV	ROI channels	Total counts	Efficiency	% yield	time (m)	Sample wt (g)	Activity (dpm)	Activity (dpm/g)	Activity (Bq/g)	ppb	ppm	molality	moles
29.37	Genie	293000	0.1037	0.1412	30	28.435	666947.43	23455.32	394.476	15119.364	15.119364	6.37813E-05	1.81E-06
57.1	Genie	8190	0.1234	0.00354	30	28.435	625109.97	21983.98	369.731	14170.929	14.170929	5.97803E-05	1.7E-06
86.48	Genie	311000	0.1396	0.124	30	28.435	598764.93	21057.47	354.148	13573.701	13.573701	5.72609E-05	1.63E-06
92.28	Genie	40000	0.1324	0.0166	30	28.435	606647.72	21334.69	358.811	13752.399	13.752399	5.80148E-05	1.65E-06
95.86	Genie	66200	0.1351	0.0268	30	28.435	609662.5	21440.72	360.594	13820.743	13.820743	5.83031E-05	1.66E-06
108.43	Genie	23700	0.1107	0.01031	30	28.435	691950.24	24334.63	409.264	15686.165	15.686165	6.61724E-05	1.88E-06
143.25	Genie	8280	0.0935	0.00443	30	28.435	666594.77	23442.92	394.267	15111.369	15.111369	6.37476E-05	1.81E-06
						Average =	637953.94	22435.68	377.327	14462.096	14.462096	6.10086E-05	1.73E-06

Sample = **NPUB-1B**
Sample wt (g) = **27.4916**

Np-237
Abundances (%yield) taken from IAEA Nudat database

Energy keV	ROI channels	Total counts	Efficiency	% yield	time (m)	Sample wt (g)	Activity (dpm)	Activity (dpm/g)	Activity (Bq/g)	ppb	ppm	molality	moles
29.37	Genie	309000	0.1037	0.1412	30	27.492	703367.77	25584.82	430.29	16492.046	16.492046	6.9572E-05	1.91E-06
57.1	Genie	8640	0.1234	0.00354	30	27.492	659456.68	23987.57	403.427	15462.451	15.462451	6.52286E-05	1.79E-06
86.48	Genie	321000	0.1396	0.124	30	27.492	618017.83	22480.24	378.077	14490.824	14.490824	6.11298E-05	1.68E-06
92.28	Genie	41300	0.1324	0.0166	30	27.492	626363.77	22783.82	383.182	14686.513	14.686513	6.19553E-05	1.7E-06
95.86	Genie	69300	0.1351	0.0268	30	27.492	638211.65	23214.79	390.431	14964.313	14.964313	6.31272E-05	1.74E-06
108.43	Genie	12300	0.1107	0.01031	30	27.492	359113.42	13062.66	219.69	8420.225	8.420225	3.55209E-05	9.77E-07
143.25	Genie	8020	0.0935	0.00443	30	27.492	645663.05	23485.83	394.989	15139.028	15.139028	6.38643E-05	1.76E-06
						Average =	607170.59	22085.68	371.441	14236.486	14.236486	6.00569E-05	1.65E-06

Sample = **NPUB-1C**
Sample wt (g) = **26.1965**

Np-237
Abundances (%yield) taken from IAEA Nudat database

Energy keV	ROI channels	Total counts	Efficiency	% yield	time (m)	Sample wt (g)	Activity (dpm)	Activity (dpm/g)	Activity (Bq/g)	ppb	ppm	molality	moles
29.37	Genie	311000	0.1037	0.1412	30	26.197	707920.31	27023.47	454.486	17419.4	17.4194	7.34841E-05	1.93E-06
57.1	Genie	8670	0.1234	0.00354	30	26.197	661746.46	25260.87	424.842	16283.225	16.283225	6.86911E-05	1.8E-06
86.48	Genie	312000	0.1396	0.124	30	26.197	600690.22	22930.17	385.644	14780.849	14.780849	6.23533E-05	1.63E-06
92.28	Genie	40400	0.1324	0.0166	30	26.197	612714.2	23389.16	393.363	15076.716	15.076716	6.36014E-05	1.67E-06
95.86	Genie	66900	0.1351	0.0268	30	26.197	616109.08	23518.76	395.543	15160.252	15.160252	6.39538E-05	1.68E-06
108.43	Genie	22000	0.1107	0.01031	30	26.197	642316.68	24519.18	412.368	15805.128	15.805128	6.66742E-05	1.75E-06
143.25	Genie	8320	0.0935	0.00443	30	26.197	669815.03	25568.87	430.022	16481.764	16.481764	6.95286E-05	1.82E-06
						Average =	644473.14	24601.5	413.752	15858.191	15.858191	6.68981E-05	1.75E-06

8/6/07 JP

82

Summary of gamma counting of solids recovered in NPUB experiment

Bq conversion 0.037 Bq per 2.2 dpm = 0.0168 Bq/dpm

Measured Np concentration based on gamma counting

Sample activity – total counts / (counting efficiency * % yield * counting time)

Uranophane reference peak counts

Energy keV	dpm/g
92.28	5991.79
95.86	27.27
143.25	141.79

Sample = **NPUB-1S**
Sample wt (g) = 0.0934

Np-237
Abundances (%yield) taken from IAEA Nudat database

Energy keV	ROI channels	Total counts	Estimated Uranophane counts	Corrected counts	Efficiency	% yield	time (m)	Sample wt (g)	Activity (dpm)	Activity (dpm/g)	Activity (Bq/g)	ppb	ppm	molality	moles
29.37	Genie	0	0	0	0.1356	0.1412	30	0.0934	0	0	0	0	0	0	0
57.1	Genie	0	0	0	0.2258	0.0035	30	0.0934	0	0	0	0	0	0	0
86.48	Genie	67100	0	67100	0.3244	0.124	30	0.0934	55603.07	595322	10012.232	383746.071	383.7461	0.001619	1.51E-07
92.28	Genie	16400	16788.9956	-388.9956	0.1977	0.0166	30	0.0934	-3951.015	-42302.1	-711.4442	-27268.0362	-27.26804	-0.000115	-1.07E-08
95.86	Genie	0	76.41054	-76.41054	0.2981	0.0268	30	0.0934	-318.8124	-3413.41	-57.40734	-2200.29267	-2.200293	-9.28E-06	-8.67E-10
108.43	Genie	0	0	0	0.3366	0.0103	30	0.0934	0	0	0	0	0	0	0
143.25	Genie	0	397.29558	-397.2956	0.2212	0.0044	30	0.0934	-13514.61	-144696	-2433.525	-93271.4733	-93.27147	-0.000393	-3.67E-08
								Average =	5402.661	57844.3	972.8365	37286.6098	37.28661	0.000157	1.47E-08

8/7/07 JF

Experimental solution samples from experiment NPuB and selected solution samples from NPuA were taken to DIU 01 for cation analysis by ICP and uranium analysis by ICP/MS. The purpose of these chemical analyses are to confirm precipitation of neptunium in experiments NPuA and NPuB.

Sample custody forms for the samples taken to DIU 01 are included on the following pages.

8/7/07 JF

SAMPLE LIST/CHAIN OF CUSTODY

Southwest Research Institute
Chemistry and Chemical Engineering Division
6220 Culebra Road
San Antonio, Texas 78238-5166

Shipper Name/Address: Jim Prikryl
CNWRA, Div 20, Bldg 57
GED

Client:

Client Purchase Order/Other ID:

Site/Zone ID:

Requested Turnaround:
- [x] 2 Weeks
- [ ] 3 Weeks
- [ ] Other: K

SwRI Contact: M. Ke Dunmann

Analyses Requested

Sample ID	Sample Collection Date (mm/dd/yy)	Sample Collection Time	Matrix Type	Sample Type	# of Containers	Cations by ICP (including Si)	Uranium by ICP/MS
NPuB-M1	8/6/07	0800	W		1	✓	✓
NPuB-M2					1	✓	✓
NPuB-1A					1	✓	✓
NPuB-1B					1	✓	✓
NPuB-1C					1	✓	✓
[redacted]NPuA-M7					1	✓	✓
NPuA-M8					1	✓	✓
NPuA-4A					1	✓	✓
NPuA-4B					1	✓	✓
NPuA-4C					1	✓	✓

REMARKS

Preservation
- a = HCl to pH <2
- b = HNO_3 to pH <2 (circled)
- c = H_2SO_4 to pH <2
- d = NaOH to pH >12
- e = Cool (4°C±2°C)
- f = Other (specify)

POC Jim Prikryl
x5067

Nuclear safety related, use appropriate QA procedures

Matrix Types:
- **A** – Air
- **B** – Biota
- **D** - Dust
- **E** – Emission/Stack
- **L** - Liquid
- **P** – Product
- **Sd** - Solid
- **S** – Soil
- **SED** – Sediment
- **T** - Tissue
- **W** - Water
- **WP** - Wipe

Sample Types:
- **D** - Duplicate
- **ER** – Equipment Rinsate
- **ES** – Environmental Sample
- **FB** – Field Blank
- **FD** – Field Duplicate
- **MS** – Matrix Spike
- **MSD** – Matrix Spike Dup
- **TB** – Trip Blank

Temp: 27.0°C

Therm #: 027

Comments:
823/49-60

	Date	Time
Relinquished by (Print/Signature): Jimmy Prikryl Jimmy Prikryl	8/7/07	1000
Received by (Print/Signature):		
Relinquished by (Print/Signature):		
Received by (Print/Signature):		
Relinquished by (Print/Signature):		

SwRI Project#: 20.06002.01.222

Received by SwRI Lab: (Signature)

Date: 8-7-07 Time: 1000

Samples Disposed: Date / Time

Samples Disposed by:

Div 01 COC FRM-010 (Rev 1/Nov 05)

8/7/07

SAMPLE LIST/CHAIN OF CUSTODY

Southwest Research Institute
Chemistry and Chemical Engineering Division
6220 Culebra Road
San Antonio, Texas 78238-5166

Shipper Name/ Address: Jim Pikul
CNWRA, Div 20, Bldg 57
GED

Client:

Client Purchase Order/Other ID:

Site/Zone ID:

Requested Turnaround:
- [x] 2 Weeks
- [ ] 3 Weeks
- [ ] Other:

SwRI Contact: Mike Drummond

Analyses Requested

Sample ID	Sample Collection Date (mm/dd/yy)	Sample Collection Time	Matrix Type	Sample Type	# of Containers	Cations by ICP (include Si)	Uranium by ICP/MS
NPUA-M15	8/6/07	0800	W		1	✓	✓
NPUA-M16	"	"	"		1	✓	✓
NPUA-8A	"	"	"		1	✓	✓
NPUA-8B	"	"	"		1	✓	✓
NPUA-8C	"	"	"		1	✓	✓

REMARKS

Preservation
- a = HCl to pH <2
- b = HNO_3 to pH <2
- c = H_2SO_4 to pH <2
- d = NaOH to pH >12
- e = Cool (4°C±2°C)
- f = Other (specify)

POC Jim Pikul
x5667

Nuclear safety related, use appropriate QA procedures

Matrix Types:
- A – Air
- B – Biota
- D - Dust
- E – Emission/Stack
- L - Liquid
- P – Product
- Sd - Solid
- S – Soil
- SED – Sediment
- T - Tissue
- W - Water
- WP - Wipe

Sample Types:
- D - Duplicate
- ER – Equipment Rinsate
- ES – Environmental Sample
- FB – Field Blank
- FD – Field Duplicate
- MS – Matrix Spike
- MSD – Matrix Spike Dup
- TB – Trip Blank

Temp: 27.0°C

Therm #: 027

Comments:
823/49-60

Relinquished by (Print/Signature)	Date	Time
James Pikul	8/7/07	1000
Received by (Print/Signature)	Date	Time
Relinquished by (Print/Signature)	Date	Time
Received by (Print/Signature)	Date	Time
Relinquished by (Print/Signature)	Date	Time

SwRI Project#: 20.06002.01.222

Received by SwRI Lab: (Signature)

Date: 8/7/07 Time: 1000

Samples Disposed: Date / Time

Samples Disposed by:

Div 01 COC FRM-010 (Rev 1/Nov 05)

8/7/07

8/8/07 JB

Recovery of uranophane from experiment UPEA.

Obj - recover solids (synthesized uranophane) from experiment UPEA (582/8385) for characterization by XRD and SEM.

Method: Filter and dry solids from UPEA test solutions.

Materials + Equipment

- UPEA ~~test~~ solution (UPEA-1A, UPEA-1B, UPEA-2A + UPEA-2B).
- Fisher vacuum filtration system
- membrane filters
- glass erlenmeyer flasks
- plastic sample containers.

Procedure

① Transfer UPEA test solutions individually to a Fisher vacuum filtration system with 47 mm millipore filter.

② Catch solids on filter. Rinse sample bottles with DI water & pour through filter system

8/8/07 JF

③ Allow solids to air dry

④ Transfer dried solids to plastic sample containers labeled as follows

uPEA-1A-S
uPEA-1B-S
uPEA-2A-S
uPEA-2B-S

8/10/07 JF

Preparation of uranophane samples for XRD analysis

Obj - determine mineralogy of synthetic uranophane before & after use in solubility experiments.

Method - x ray powder diffraction analysis.

Materials
- Samples uPEA-1A-S, uPEA-1B-S, uPEA-2A-S, uPEA-2B-S, uRANOPHANE-7 (325/202) + uranophane received from URSE experiment (382/110)
- agate mortar & pestle
- plastic containers

8/10/07 JP

XRD prepartn procedure.

(1) Crush portion of sample samples in agate mortar + pestle to a fine powder.

(2) Transfer crushed powders to sample containers and take to Div 18 for XRD analysis. Samples were labeled as shown below.

uPEA-1A-S-XRD
uPEA-1B-S-XRD
uPEA-2A-S-XRD
uPEA-2B-S-XRD
uRAN-7-XRD
uRSE-XRD

8/27/07 JP

Preparation of samples (synthetic urinophe) for SEM analysis

Obj - examination of leached and unleached urinophe used in experiments URSE and UPEA.

Method - SEM analysis

Materials -
- Samples URANOPHANE-7 (325/202) and leached urinophe samples UPEA-2B-S, UPEA-1A-S, and urinophe recovered from "URSE" (582/110).
- polycarbonate filter - 13 mm
- vacuum filtration system
- aluminum stubs
- carbon tape
- disposable plastic cups
- DI water
- Eppendorf pipet & plastic tips

8/27/07 yp

Procedure

(1) Place aliquot of each nanophase sample in a disposable plastic cup and add ~ 5 ml DI water. Stir solution to disperse nanoplates in solution.

(2) Draw ~ 100 ml of the solution into plastic tip using an eppendorf pipet.

(3) Pass solute through a 13 mm polycarbonate filter to capture solids onto filter

(4) Place carbon tape onto alumina SEM stub and then place polycarbonate filter with nanoplates onto carbon tape.

(5) Label samples / stubs as follows.

E - nanoplates removed from UPSE
7 - nanophase-7
A - UPEA-1A-S
B - UPEA-2B-S

(6) Take samples to DIV 18 for coating & SEM analysis