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LANL-CO ACRSP
ACP-01/2012 Rev. 0

Marian Borkowski

NUMERICAL VALUES

FOR GRAPHS PRESENTED IN REPORT LCO-ACP-17, REV.0 ENTITLED: "SOLUBILITY OF An(IV) IN WIPP BRINE: THORIUM ANALOG STUDIES IN WIPP SIMULATED BRINE" AND FOR GRAPHS PUBLISHED IN Borkowski, M., et al. Radiochimica Acta 98, (9-11) 577-582 (2010).

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LOS ALAMOS NATIONAL LABORATORY
CARLSBAD OPERATIONS

Report ACP-01/2012 Rev. 0

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Effective Date: 11-29-12

Originator:

Marian Borkowski, LANL-CO ACRSP — Date: 11/29/12

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Laurie Smith, LANL-CO Quality Assurance Manager — Date: 11/29/2012

Ned Elkins, LANL-CO Group Leader (signed: Timothy P. Burns for N'ZE) — Date: 11/29/2012

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This data report is provided as input to the Department of Energy (DOE) Compliance Recertification Application (CRA), CRA-2014 recertification effort and is in response to a request by Sandia National Laboratories, with DOE-Carlsbad Field Office (CBFO) concurrence, for the underlying data in a number of Figures in completed or published reports. The LCO-ACP-17 report was quality level 1 research to establish the solubility of thorium (IV) in WIPP brine and is supported by existing data packages and quality assurance (QA) documentation that is in the LANL-CO records center. The Borkowski et al., publication was qualified through the journal peer-review process.

Specifics of the Request for Information Received

On October 30, 2012, ACRSP received the following request from DOE-CBFO.

"Could you please provide us with the actual numerical values of actinide-solubility and other compositional data that were presented graphically in a recent paper and a report? We need the actual numerical values so that we can include these results in our uncertainty analysis for the CRA-2014.

The specific data that we need are described below.

Borkowski et al. (2010):

Section 3. Results and discussion

- *Numerical values of the free $HB_4O_7^-$ and total Nd concentrations (both M) for the data plotted in Figure 2*
- *Numerical values of the total $Na_2B_4O_7$ and total Nd concentrations (both M) for the data plotted in Figure 3*

Borkowski et al. (2012):

Section 3.0: Thorium Solubility in Carbonate-Free Brine

- *Numerical values of the pcH and Th concentrations (M) for the data plotted in Figures 6, 7, 8, 9, and 10*
- *Compositions of the GWB and ERDA-6 used in these experiments. Did you simulate the compositions of these WIPP brines before or after equilibration with solids in the repository (especially MgO)? Were these brines analyzed at the start of these experiments? Were they reanalyzed at the same times that the pcH and Th concentrations were measured?*

Section 4.0: Thorium Solubility in the Presence of Carbonate

- *Numerical values of the pcH and Th concentrations (M) for the data plotted in Figures 13, 14a, 14b, and 15*
- *Same questions about the compositions of GWB and ERDA-6*

Section5.0: Contribution of Colloids

- *Numerical values of the pcH and Th concentrations (M) for the data plotted in Figures 16, 17, and 18*
- *Same questions about the compositions of GWB and ERDA-6*

REFERENCES

Borkowski, M., M. Richmann, and J.F. Lucchini. 2012. *Solubility of An(IV) in WIPP Brine: Thorium Analog Studies in WIPP Simulated Brine*. LCO-ACP-17. Carlsbad, NM: Los Alamos National Laboratory – Carlsbad Operations, LA-UR 12-24417.

Borkowski, M., M. Richmann, D.T. Reed, and Y. Xiong. 2010. "Complexation of Nd(III) with Tetraborate Ion and Its Effect on Actinide(III) Solubility in WIPP Brine, "*Radiochimica Acta*. Vol. 98, nos. 9-11 (Migration 2009), 577–582."

Requested Data and Explanation of Figures

The following data and explanations are provided in response to the above DOE-CBFO request. In addition to a list of data in the Figures identified, further clarification of how the experiments were performed, something that was also requested, is provided.

Composition of ERDA-6 and GWB Brines Used

The following compositions of ERDA-6 and GWB brines were used in the reported experiments.

Table 1. Composition and Density of GWB and ERDA-6 Simulated WIPP Brines

Component	**GWB** (M)	**ERDA-6 brine** (M)
NaCl	2.874	4.254
$MgCl_2$	0.953	0.018
Na_2SO_4	0.166	0.159
NaBr	0.025	0.010
$Na_2B_4O_7$	0.037	0.015
KCl	0.437	0.092
$CaCl_2$	0.013	0.011
LiCl	0.004	-
Density g/mL	1.216	1.183

In all the Figures and results presented, we are stating the pH in terms of pC_{H+} i.e. the negative logarithm of hydrogen ion concentration measured according to our procedure *Determination of Hydrogen Ion Concentration in Brine* (ACP-EXP-010). Operationally, this is the measured pH that is corrected based on the ionic strength of the brine (typically ~ 0.94 for ERDA-6 and 1.23 for GWB brine). Initial pC_{H+} was adjusted using NaOH and HCl solutions. The pC_{H+} values reported in the Tables/Figures are those measured at the time the thorium concentration was measured (i.e., the equilibrated not initial pC_{H+}).

These brines were not equilibrated with any solid that is expected in the WIPP repository (such as MgO, hydromagnesite, magnesite etc.). In the case of GWB, however, precipitation of magnesium phases occurred above pC_{H+} ~9. This changes the composition of GWB brine in a way that is documented in the ACRSP brine titration experiments summarized in the *WIPP Actinide-Relevant Brine Chemistry* (LCO-ACP-15) report (see Table 2 below). These titration results were in agreement, for the most part, with the values predicted by the reacted brine composition vs. pC_{H+} calculated by SNL [Brush et al. 2011].

Brush, L.H., Domski, P.S., Xiong Y.-L."Predictions of the Compositions of Standard WIPP Brines as a Function of pcH for Laboratory Studies of the Speciation and Solubilities of Actinides." Analysis report, June 23, 2011. Carlsbad, NM: Sandia National Laboratories (2011).

Table 2 (from LCO-ACP-15). WIPP-relevant brine compositions as a function of pC_{H+} . Data are based on the experimental GWB (100% saturated formulation) pH titration experiments (Task 2, Subtask 1). Composition of full strength GWB and ERDA-6 brines (100% saturated formulation) is also given in italic format.

pC_{H+}	Element/Species - Measured Concentrations, M								
	Na^+	K^+	Mg^{2+}	Ca^{2+}	Li^+	$B_4O_7^{2-}$	Cl^-	SO_4^{2-}	Br^-
GWB	*3.53E+00*	*4.67E-01*	*1.02E+00*	*1.38E-02*	*4.48E-03*	*3.95E-02*	*5.6E+00*	*1.77E-01*	*2.66E-02*
9	3.50E+00	4.58E-01	1.03E+00	1.35E-02	3.75E-03	3.89E-02	5.43E+00	1.76E-01	2.35E-02
9.5	3.72E+00	4.59E-01	8.50E-01	1.31E-02	3.70E-03	1.64E-02	5.55E+00	1.76E-01	2.42E-02
10	4.59E+00	4.50E-01	1.17E-01	1.34E-02	3.57E-03	2.77E-03	5.35E+00	1.69E-01	2.34E-02
10.5	4.91E+00	4.54E-01	2.86E-02	1.24E-02	3.54E-03	1.66E-02	5.39E+00	1.69E-01	2.32E-02
ERDA-6	*4.87E+00*	*9.70E-02*	*1.90E-02*	*1.20E-02*	*N/A*	*1.58E-02*	*4.80E+00*	*1.70E-01*	*1.10E-02*
11	4.96E+00	4.49E-01	1.11E-02	1.09E-02	3.54E-03	3.05E-02	5.31E+00	1.68E-01	2.30E-02
12	5.02E+00	4.54E-01	1.05E-02	6.97E-03	3.46E-03	3.29E-02	5.31E+00	1.69E-01	2.32E-02
13	5.11E+00	4.52E-01	9.74E-03	2.14E-03	3.55E-03	2.99E-02	5.32E+00	1.67E-01	2.35E-02

Experimental error

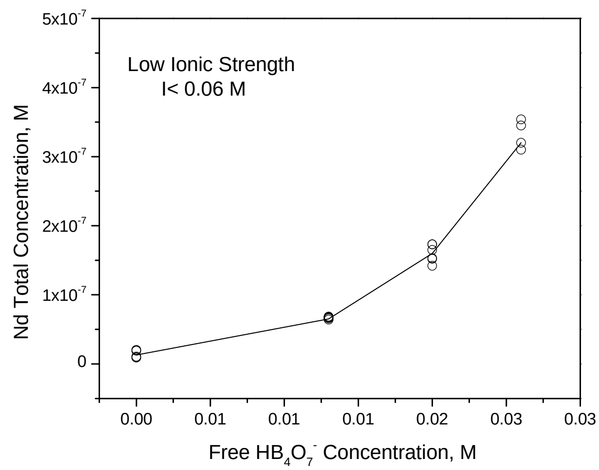
Samples were analyzed for thorium content using an inductively coupled plasma mass spectrometer (ICP-MS) Elan model 6000 or Agilent 7500. To obtain good consistency and to account for matrix effects, an internal standard (Indium-115) was used in the analyses, and thorium standards (High Purity Standards) that are NIST traceable were used for instrument calibration. Aliquots of the filtrates were diluted 100 times in nitric acid due to the high salt concentration and to establish thorium concentrations within the range of the ICP-MS calibration. The determination limit by ICP-MS for thorium was ~10^{-11} M, which was effectively ~10^{-9} M for our experiments due to the sample dilutions.

The overall uncertainty in the thorium concentration determination was evaluated to be about 10% at 10^{-7} M, about 50% at 10^{-8} M, and 100% for thorium concentrations at 10^{-9} M.

All data were collected in compliance with the DOE CBFO Quality Assurance Program Document under the LANL-CO QA Program. The analytical data package(s) that support this work are in the LANL-CO Record Center. These data packages contain raw spectra and other relevant data. The relevant individual data points are captured in the charts included in this report.

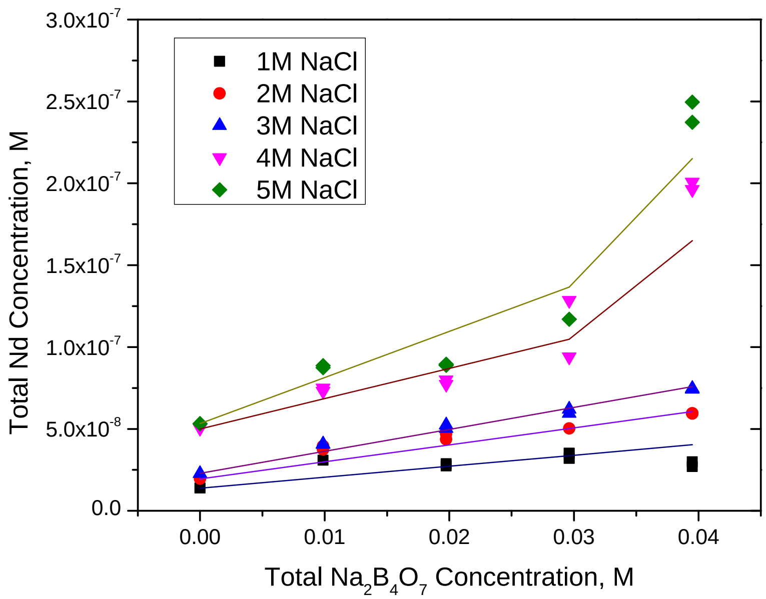
Data Supporting Published Figures

Borkowski, M., et al. 2010, "Complexation of Nd(III) with Tetraborate Ion …", Section 3, Figure 2



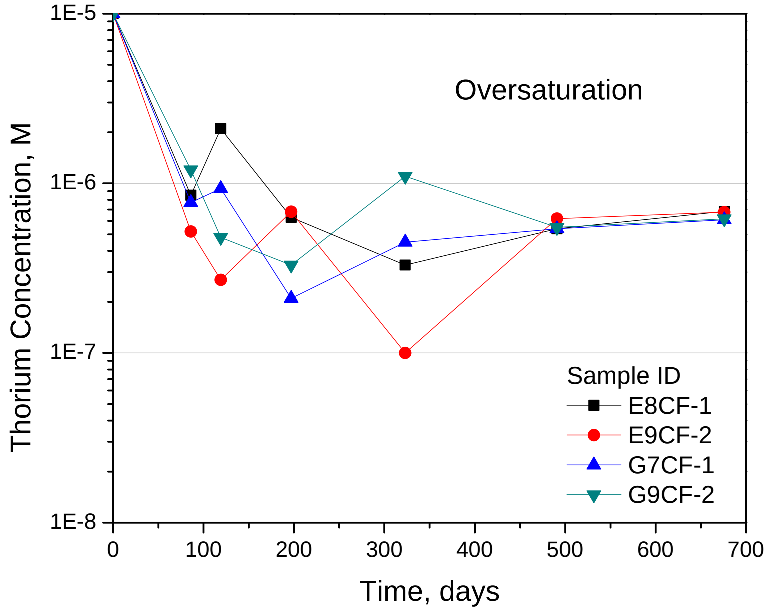
Sample ID	[Total Ligand], M	[Free HB4O7-], M	[Nd], M
B0-C1	0	0	9.25E-09
B0-D1	0	0	2.02E-08
B0-C2	0	0	9.42E-09
B0-D2	0	0	1.9E-08
B0-C3	0	0	1.06E-08
B0-D3	0	0	2.02E-08
B5-C1	0.05	0.013	6.63E-08
B5-D1	0.05	0.013	6.78E-08
B5-C2	0.05	0.013	6.73E-08
B5-D2	0.05	0.013	6.86E-08
B5-C3	0.05	0.013	6.6E-08
B5-D3	0.05	0.013	6.4E-08
B7-C1	0.075	0.02	1.53E-07
B7-D1	0.075	0.02	1.73E-07
B7-C2	0.075	0.02	1.52E-07
B7-D2	0.075	0.02	1.73E-07
B7-C3	0.075	0.02	1.42E-07
B7-D3	0.075	0.02	1.65E-07
B10-C1	0.1	0.026	3.2E-7
B10-D1	0.1	0.026	3.45E-7
B10-C2	0.1	0.026	3.54E-7
B10-C3	0.1	0.026	3.1E-7

Borkowski, M., et al. 2010, “Complexation of Nd(III) with Tetraborate Ion …”, Section 3, Figure 3



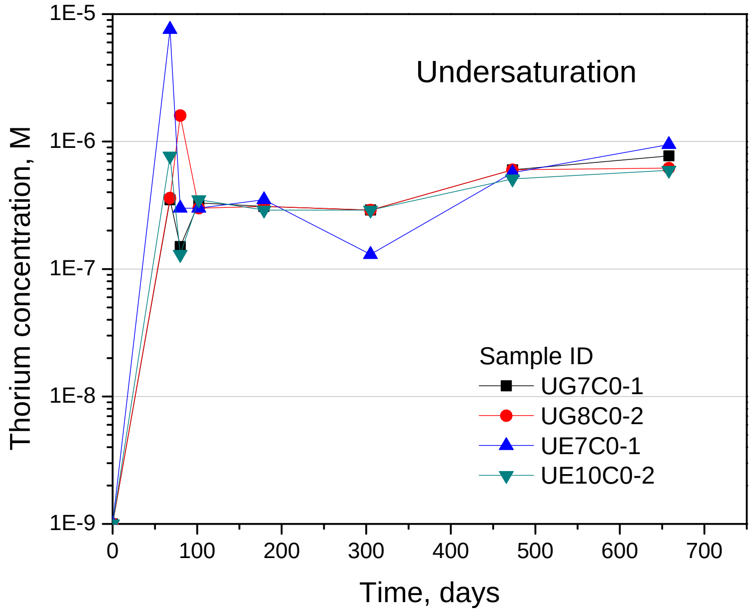
Total Tetraborate, M	Total Nd concentration, M				
	1M NaCl	2M NaCl	3M NaCl	4M NaCl	5M NaCl
0	1.39E-08	1.96E-08	2.27E-08	5.04E-08	5.32E-08
0.0099	3.09E-08	3.75E-08	4.08E-08	7.30E-08	8.86E-08
0.0099	3.09E-08	3.96E-08	4.05E-08	7.50E-08	8.74E-08
0.0198	2.74E-08	4.36E-08	5.25E-08	7.99E-08	8.94E-08
0.0198	2.88E-08	4.70E-08	5.03E-08	7.72E-08	8.89E-08
0.0296	3.51E-08	5.04E-08	5.95E-08	1.28E-07	1.17E-07
0.0296	3.20E-08	5.03E-08	6.21E-08	9.40E-08	1.17E-07
0.0395	2.99E-08	5.93E-08	7.43E-08	1.96E-07	2.50E-07
0.0395	2.70E-08	5.96E-08	7.47E-08	2.01E-07	2.37E-07

LCO-ACP-17, p. 18, Figure 6



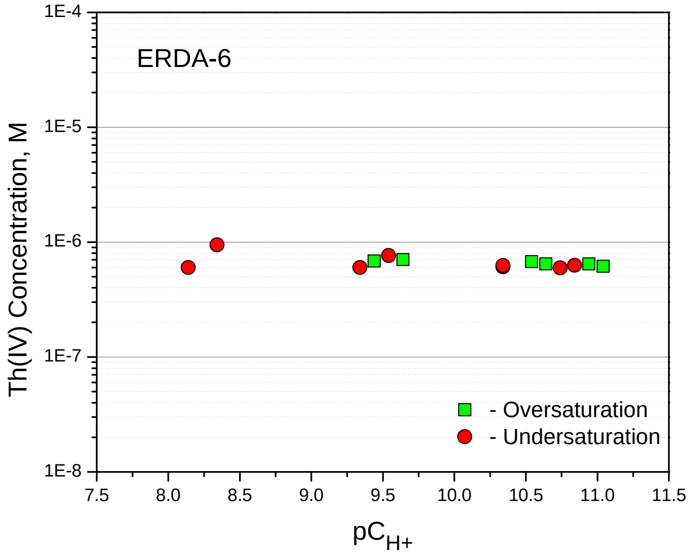
Days	Th concentrations, M			
	E8CF-1	E9CF-2	G7CF-1	G9CF-2
0	1E-5	1E-5	1E-5	1E-5
87	8.5E-7	5.2E-7	7.7E-7	1.2E-6
120	2.1E-6	2.7E-7	9.3E-7	4.8E-7
204	6.3E-7	6.8E-7	2.1E-7	3.3E-7
330	3.3E-7	1.0E-7	4.5E-7	1.1E-6
497	5.4E-7	6.2E-7	5.4E-7	5.5E-7
681	6.8E-7	6.8E-7	6.1E-7	6.2E-7
pC_H				
681	9.4	10.5	7.4	10.1

LCO-ACP-17, p. 20, Figure 7



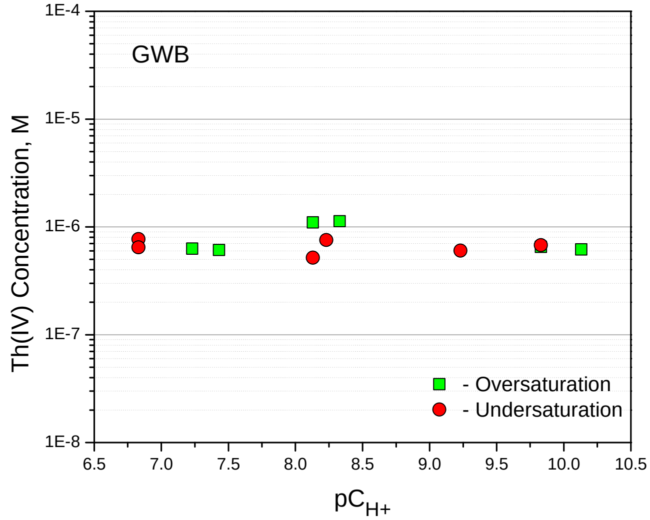
Days	Th concentrations, M			
	UG7C0-1	UG8C0-2	UE7C0-1	UE10C0-2
0	1E-9	1E-9	1E-9	1E-9
67	3.5E-7	3.6E-7	7.6E-6	7.7E-7
79	1.5E-7	1.6E-6	3.0E-7	1.3E-7
101	3.3E-7	3.0E-7	3.0E-7	3.5E-7
184	3.1E-7	3.1E-7	3.5E-7	2.9E-7
310	2.9E-7	2.9E-7	1.3E-7	2.9E-7
477	6.0E-7	6.0E-7	5.7E-7	5.1E-7
661	7.7E-7	6.2E-7	9.5E-7	6.0E-7
pC_H				
661	6.8	8.1	8.3	10.7

LCO-ACP-17, p. 21, Figure 8



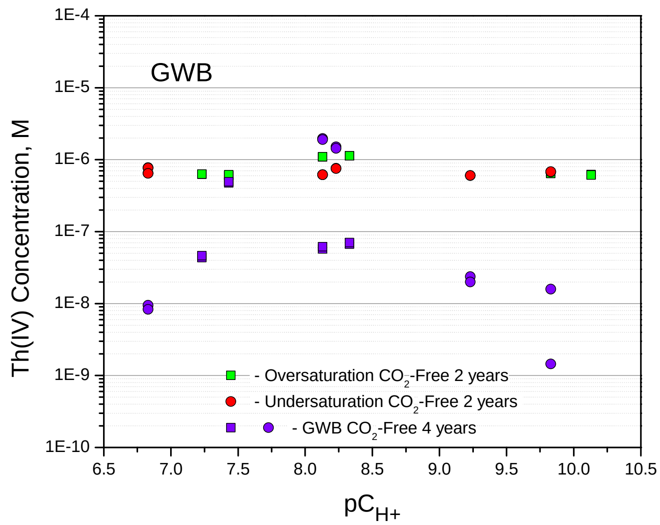
Sample ID	pC_H	Th concentrations, M		
		7th run A	7th run B	Average
Undersaturation				
UE7C0-1	8.34	9.50E-7	9.45E-7	9.48E-7
UE7C0-2	8.14	5.94E-7	6.09E-7	6.02E-7
UE8C0-1	9.54	7.57E-7	7.71E-7	7.64E-7
UE8C0-2	9.34	6.03E-7	6.00E-7	6.02E-7
UE9C0-1	10.34	6.07E-7	6.10E-7	6.09E-7
UE9C0-2	10.34	6.22E-7	6.28E-7	6.25E-7
UE10C0-1	10.84	6.25E-7	6.32E-7	6.29E-7
UE10C0-2	10.74	5.94E-7	5.98E-7	5.96E-7
Oversaturation				
E8CF-1	9.44	7.48E-7	6.19E-7	6.84E-7
E8CF-2	9.64	7.49E-7	6.58E-7	7.04E-7
E9CF-1	10.64	6.82E-7	6.11E-7	6.47E-7
E9CF-2	10.54	7.25E-7	6.27E-7	6.76E-7
E10CF-1	10.94	6.66E-7	6.28E-7	6.47E-7
E10CF-2	11.04	6.38E-7	5.94E-7	6.16E-7

LCO-ACP-17, p. 22, Figure 9



Sample ID	pC_H	Th concentrations, M		
		7th run A	7th run B	Average
Undersaturation				
UG7C0-1	6.83	7.74E-7	7.69E-7	7.72E-7
UG7C0-2	6.83	6.49E-7	6.44E-7	6.47E-7
UG8C0-1	8.23	7.59E-7	7.53E-7	7.56E-7
UG8C0-2	8.13	6.19E-7	6.19E-7	5.19E-7
UG9C0-1	9.23	6.02E-7	6.03E-7	6.03E-7
UG9C0-2	9.83	6.76E-7	6.80E-7	6.78E-7
Oversaturation				
G8CF-1	7.43	6.03E-7	6.18E-7	6.11E-7
G8CF-2	7.23	6.27E-7	6.30E-7	6.29E-7
G9CF-1	8.13	1.09E-6	1.10E-6	1.10E-6
G9CF-2	8.33	1.13E-6	1.13E-6	1.13E-6
G10CF-1	9.83	6.44E-7	6.64E-7	6.54E-7
G10CF-2	10.13	6.22E-7	6.14E-7	6.18E-7

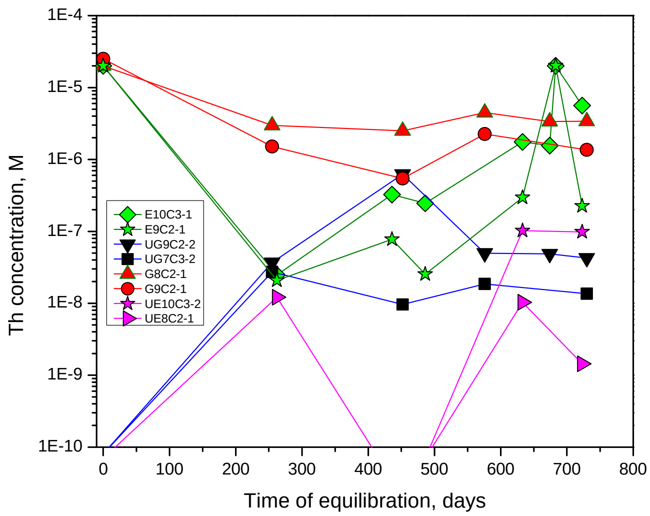
LCO-ACP-17, p. 23, Figure 10



Sample ID	pC_H	Th concentrations, M (2 years)			Th concentrations, M (4 years)		
		7th run A	7th run B	Average	Run A	Run B	Average
Undersaturation							
UG7C0-1	6.83	7.74E-7	7.69E-7	7.72E-7	*	*	
UG7C0-2	6.83	6.49E-7	6.44E-7	6.47E-7	8.31E-9	9.47E-9	8.89E-9
UG8C0-1	8.23	7.59E-7	7.53E-7	7.56E-7	1.44E-6	1.51E-6	1.48E-6
UG8C0-2	8.13	6.19E-7	6.19E-7	5.19E-7	1.90E-6	1.97E-6	1.94E-6
UG9C0-1	9.23	6.02E-7	6.03E-7	6.03E-7	2.00E-8	2.37E-8	2.19E-8
UG9C0-2	9.83	6.76E-7	6.80E-7	6.78E-7	1.45E-9	1.59E-8	1.52E-8
Oversaturation							
G8CF-1	7.43	6.03E-7	6.18E-7	6.11E-7	4.76E-7	4.93E-7	4.85E-7
G8CF-2	7.23	6.27E-7	6.30E-7	6.29E-7	4.36E-8	4.62E-8	4.49E-8
G9CF-1	8.13	1.09E-6	1.10E-6	1.10E-6	5.76E-8	6.18E-8	5.97E-8
G9CF-2	8.33	1.13E-6	1.13E-6	1.13E-6	6.69E-8	7.05E-8	6.87E-8
G10CF-1	9.83	6.44E-7	6.64E-7	6.54E-7	*	*	
G10CF-2	10.13	6.22E-7	6.14E-7	6.18E-7	*	*	

* - Th concentration was below the determination limit

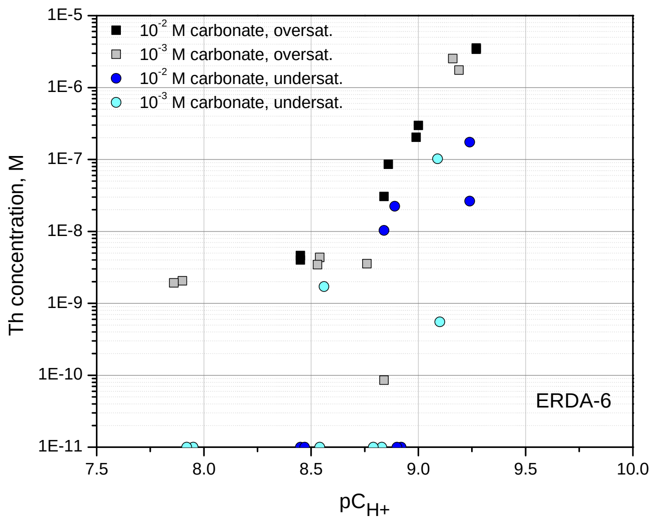
LCO-ACP-17, p. 27, Figure 13



Days	Th concentrations for the certain samples @ various equilibration time							
	E10C3-1	UG9C2-2	G8C2-1	G9C2-1	UG7C3-2	E9C2-1	UE10C3-2	UE8C2-1
0	2.00E-05	*	2.00E-05	2.00E-05	*	2.00E-05	*	*
255		3.69E-08	2.98E-06	1.51E-06	2.73E-08			
262	2.47E-08					2.08E-08	*	1.21E-08
416	3.25E-07					7.74E-08	*	*
452		6.23E-07	2.50E-06	5.42E-07	9.61E-09			
486	2.45E-07					2.54E-08	*	*
576		4.98E-08	4.47E-06	2.26E-06	1.86E-08			
633	1.75E-06					2.96E-07	1.02E-07	1.03E-08
674	1.56E-06	4.85E-08	3.37E-06					
683	2.00E-05					2.00E-05		
723	5.60E-06					2.25E-07	9.84E-08	1.44E-09
730		4.25E-08	3.39E-06	1.36E-06	1.36E-08			
pCH								
	E10C3-1	UG9C2-2	G8C2-1	G9C2-1	UG7C3-2	E9C2-1	UE10C3-2	UE8C2-1
0	9.60	9.10	8.69	9.11	8.05	9.17	9.58	9.02
End	9.19	9.11	8.54	9.03	7.96	9.00	9.09	8.84

*- thorium concentration was below the determination limit

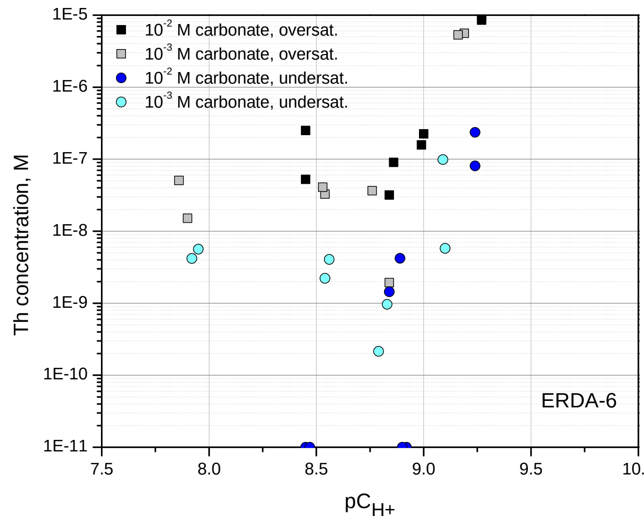
LCO-ACP-017, p. 28, Figure 14A



ERDA-6 oversaturation				ERDA-6 undersaturation		
Sample ID	pCH	[Th], M		Sample ID	pCH	[Th], M
E7C2-1	8.45	4.62E-9		UE7C2-1	8.45	*
E7C2-2	8.45	4.00E-9		UE7C2-2	8.47	*
E8C2-1	8.84	3.06E-8		UE8C2-1	8.84	1.03E-8
E8C2-2	8.86	8.57E-8		UE8C2-2	8.89	2.24E-8
E9C2-1	9.00	2.96E-7		UE9C2-1	8.92	*
E9C2-2	8.99	2.03E-7		UE9C2-2	8.90	*
E10C2-1	9.27	3.4E-6		UE10C2-1	9.24	2.64E-8
E10C2-2	9.27	3.54E-6		UE10C2-2	9.24	1.74E-7
E7C3-1	7.90	2.06E-9		UE7C3-1	7.95	*
E7C3-2	7.86	1.92E-9		UE7C3-2	7.92	*
E8C3-1	8.54	4.34E-9		UE8C3-1	8.54	*
E8C3-2	8.53	3.46E-9		UE8C3-2	8.56	1.71E-9
E9C3-1	8.76	3.55E-9		UE9C3-1	8.83	*
E9C3-2	8.84	8.58E-11		UE9C3-2	8.79	*
E10C3-1	9.19	1.75E-6		UE10C3-1	9.10	5.52E-10
E10C3-2	9.16	2.52E-6		UE10C3-2	9.09	1.02E-7

*- thorium concentration was below the determination limit

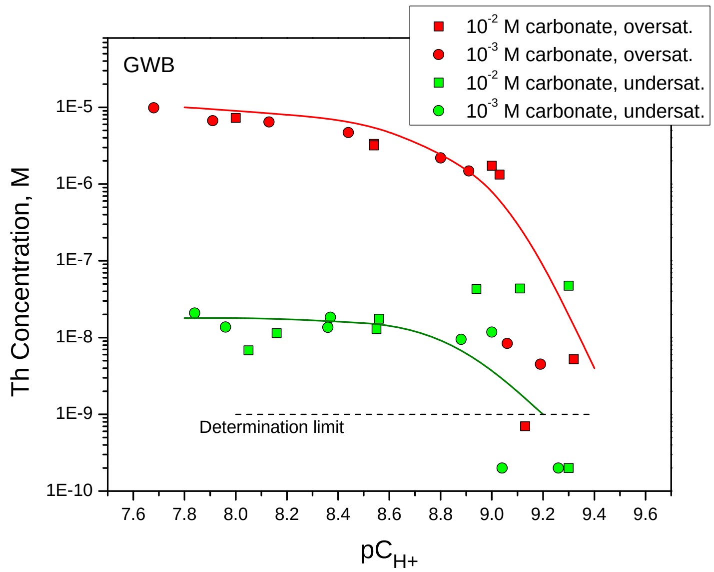
LCO-ACP-017, p. 29, Figure 14B



ERDA-6 oversaturation				ERDA-6 undersaturation		
Sample ID	pCH	[Th], M		Sample ID	pCH	[Th], M
E7C2-1	8.45	5.24E-8		UE7C2-1	8.45	*
E7C2-2	8.45	2.5E-7		UE7C2-2	8.47	*
E8C2-1	8.84	3.18E-8		UE8C2-1	8.84	1.44E-9
E8C2-2	8.86	9.01E-8		UE8C2-2	8.89	4.2E-9
E9C2-1	9.00	2.25E-7		UE9C2-1	8.92	*
E9C2-2	8.99	1.58E-7		UE9C2-2	8.90	*
E10C2-1	9.27	9.48E-6		UE10C2-1	9.24	8.06E-8
E10C2-2	9.27	8.48E-6		UE10C2-2	9.24	2.36E-7
E7C3-1	7.90	1.51E-8		UE7C3-1	7.95	5.63E-9
E7C3-2	7.86	5.04E-8		UE7C3-2	7.92	4.18E-9
E8C3-1	8.54	3.28E-8		UE8C3-1	8.54	2.22E-9
E8C3-2	8.53	4.08E-8		UE8C3-2	8.56	4.06E-9
E9C3-1	8.76	3.66E-8		UE9C3-1	8.83	9.65E-10
E9C3-2	8.84	1.93E-9		UE9C3-2	8.79	2.15E-10
E10C3-1	9.19	5.57E-6		UE10C3-1	9.10	5.77E-9
E10C3-2	9.16	5.33E-6		UE10C3-2	9.09	9.84E-8

*- thorium concentration was below the determination limit

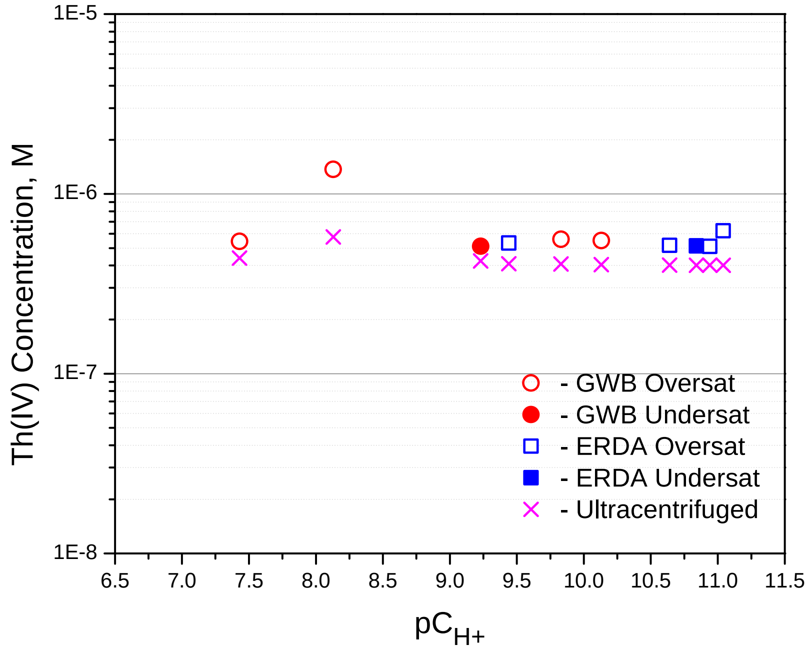
LCO-ACP-017, p. 30, Figure 15



ERDA-6 oversaturation				ERDA-6 undersaturation		
Sample ID	pCH	[Th], M		Sample ID	pCH	[Th], M
G7C2-1	8.06	6.42E-6		UG7C2-1	8.05	6.83E-9
G7C2-2	8.00	7.24E-6		UG7C2-2	8.16	1.14E-8
G8C2-1	8.54	3.33E-6		UG8C2-1	8.55	1.29E-8
G8C2-2	8.54	3.18E-6		UG8C2-2	8.56	1.76E-8
G9C2-1	9.03	1.33E-6		UG9C2-1	8.94	4.27E-8
G9C2-2	9.00	1.73E-6		UG9C2-2	9.11	4.35E-8
G10C2-1	9.32	5.23E-9		UG10C2-1	9.30	4.74E-8
G10C2-2	9.13	7.00E-10		UG10C2-2	9.30	*
G7C3-1	7.68	9.87E-6		UG7C3-1	7.84	2.09E-8
G7C3-2	7.91	6.68E-6		UG7C3-2	7.96	1.37E-8
G8C3-1	8.44	4.69E-6		UG8C3-1	8.36	1.36E-8
G8C3-2	8.13	6.45E-6		UG8C3-2	8.37	1.84E-8
G9C3-1	8.80	2.19E-6		UG9C3-1	8.88	9.50E-9
G9C3-2	8.91	1.48E-6		UG9C3-2	9.00	1.18E-8
G10C3-1	9.06	8.40E-9		UG10C3-1	9.26	*
G10C3-2	9.19	4.49E-9		UG10C3-2	9.04	*

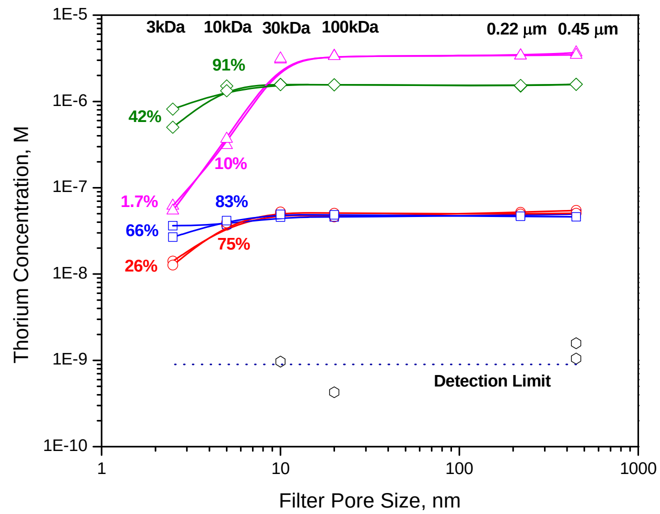
*- thorium concentration was below the determination limit

LCO-ACL-017, p. 31, Figure 16



Sample ID	pC_H	[Th], M - before ultracentr. (Run 7th)	[Th], M - after ultracentrifugation
UG9C0-1	9.23	5.11E-7	4.23E-7
G7CF-1	7.43	5.44E-7	4.39E-7
G8CF-1	8.13	1.37E-6	5.76E-7
G9CF-1	9.83	5.59E-7	4.07E-7
G9CF-2	10.13	5.51E-7	4.04E-7
UE10C0-1	10.84	5.13E-7	4.01E-7
E8CF-1	9.44	5.33E-7	4.09E-7
E9CF-1	10.64	5.17E-7	4.02E-7
E10CF-1	10.94	5.10E-7	4.02E-7
E10CF-2	11.04	6.24E-7	4.01E-7

LCO-ACP-017, p.32, Figure 17 and p. 33, Figure 18 (contains the same data but plotted differently)



Manuf. NMWL	Pore size, nm	Th concentrations, M (1st run)					Th concentrations, M (2nd run)			
		UG8C0-2	G8C2-1	UG9C2-2	E10C3-1		UG8C0-2	G8C2-1	UG9C2-2	E10C3-1
0.45 μm	450	5.47E-8	3.68E-6	4.95E-8	1.58E-6		5.07E-8	3.46E-6	4.60E-8	1.58E-6
0.22 μm	220	5.20E-8	3.39E-6	4.79E-8	1.51E-6		4.96E-8	3.39E-6	4.66E-8	1.53E-6
100 kD	20	4.59E-8	3.37E-6	4.58E-8	1.56E-6		5.07E-8	3.34E-6	4.85E-8	1.56E-6
30kD	10	4.99E-8	3.06E-6	4.57E-8	1.58E-6		5.24E-8	3.13E-6	4.92E-8	1.57E-6
10 kD	5	3.66E-8	3.11E-7	3.76E-8	1.51E-6		3.93E-8	3.68E-7	4.16E-8	1.33E-6
3 kD	2.5	1.41E-8	6.17E-8	3.63E-8	5.02E-7		1.27E-8	5.43E-8	2.68E-8	8.14E-7
		UG8C0-2	G8C2-1	UG9C2-2	E10C3-1		UG8C0-2	G8C2-1	UG9C2-2	E10C3-1
	pC_H	8.13	8.54	9.11	9.18		8.13	8.54	9.11	9.18