### APPENDIX G SUMMARY OF LITERATURE SOLUBILITY STUDIES

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### SUMMARY OF LITERATURE SOLUBILITY STUDIES

### 1.0 INTRODUCTION

7 To obtain relevant solubility data on the actinides of interest, a literature search was conducted 8 and solubility studies on actinide-bearing solids (e.g., Pu(OH)<sub>3</sub>, UO<sub>2</sub>) were compiled into a data base. The data base Attachment 1 contains records that provide information on the solid phase, 9 solution composition, solution description (e.g., dilute, saline or brine), actinide concentration in 10 solution, pH, Eh or atmospheric conditions, temperature, equilibration time of the experimental 11 12 run, method employed to determine the solubility (e.g., equilibrium approached from an oversaturated solution, calculated with a geochemical code, etc), and reference for the study. 13 14 Most of the results tabulated in Attachment 1 are presented graphically for the actinides Thorium 15 (Th), Uranium (U), Neptunium (Np), Plutonium (Pu), and Americium (Am) in coordinates of log 16 molar concentration (molar (M) = moles/liter) versus pH.

#### 2.0 THORIUM

Thorium is only stable in the IV valence state in the natural environment. Solubility is usually controlled by thorianite (ThO<sub>2</sub>). Th(OH)<sub>4</sub> may initially precipitate from an oversaturated solution, but it will age to the more stable ThO<sub>2</sub> (Brookins, 1988).

Figure G-1 summarizes data on Th solubility in saline and brine chloride solutions as reported by 6 Felmy et al. (1991). The solubility of the Th precipitate decreases approximately 6 orders of 27 28 magnitude over the pH interval of 3 to 6, followed by a flattening of the trend above a pH of 6. 29 Precipitates obtained from these experiments were analyzed by x-ray diffraction (XRD) techniques 30 and found to be amorphous to x-rays until they had been aged for about a year. Some of the 31 372-day precipitate obtained from the 3M NaCI experiment displayed an XRD pattern similar to crystalline ThO<sub>2</sub>. However, these samples do not show significantly different solubilities, and 32 33 Felmy et al. (1991) concluded that an amorphous phase still controls the solubility despite the 34 presence of some crystalline precipitate.

Based on thermodynamic solubility calculations at  $25^{\circ}$ C and 1 atm in dilute solutions (e.g., Langmuir and Herman, 1980), the thorianite (crystalline ThO<sub>2</sub>) solubility trend lies 4 to 5 orders of magnitude below the trend of the amorphous hydrous Th oxide indicated on Figure G-1. As Th occurs in transuranic waste primarily as oxides (Weiner, 1995), and the hydrous Th oxide is more soluble than the crystalline oxide form, solubility data on Figure G-1 represent a conservative (upper bound) estimate of Th solubility.

### 3.0 URANIUM

The dominant valence states for U in the natural environment are IV and VI. Uranium (VI) is much more soluble that U (IV), and has a strong affinity for carbonate complexation. Important solubility-controlling minerals include uraninite (UO<sub>2</sub>) for U (IV), and schoepite (UO<sub>3</sub>•2H<sub>2</sub>O) for

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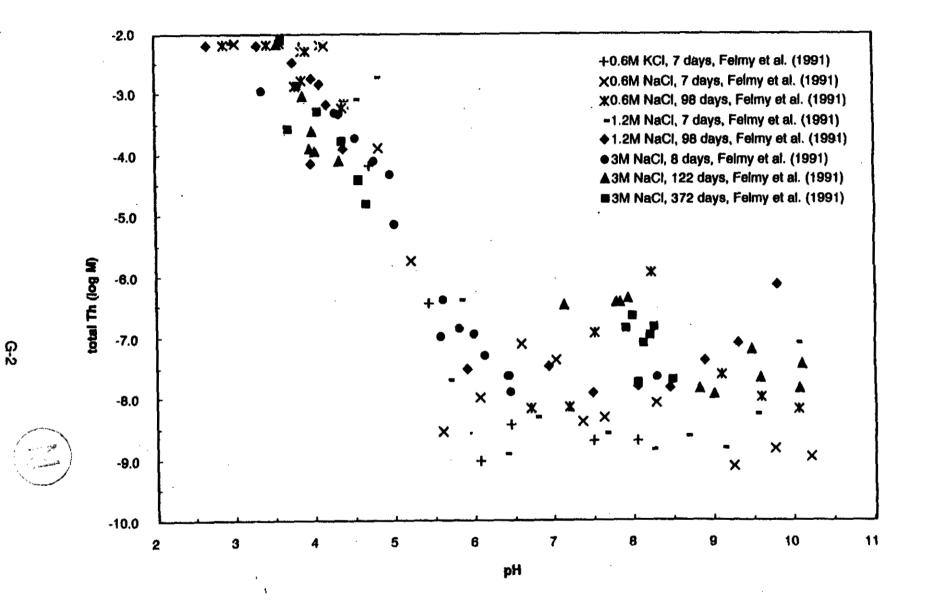


Figure G-1 Hydrous Th(IV) Oxide Solubility as a Function of pH for dilute and Brine Solutions

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U (VI). The presence of organic materials and corrodable metals in the repository environment 2 will probably restrict U to the IV state.

4 Figure G-2 summarizes U solubility data for uraninite (UO<sub>2</sub>). Solubility data reported by Parks and 5 Pohl (1988) for UO<sub>2</sub> at 100 and 150°C in dilute NaCl solution (0.1 M) indicate a decrease in the 6 concentration of U from -7 to -9.5 log M as pH increases from 1 to 7. Gray (1986) investigated 7 the solubility of unirradiated UO<sub>2</sub> fuel-rod pellets in a saturated NaCl brine of pH 6.2 to 6.4 and 8 reported U concentrations of -7 to -8 log M, about 1.5 to 2.5 orders of magnitude lower than UO, 9 solubility values in dilute NaCl solutions. The solubility data of Gray (1986) serve as a conservative estimate of U concentrations in Salado brine, because the solubility of UO<sub>2</sub> increases 10 11 with temperature and the solubility data were obtained at elevated temperatures, relative to the 12 ambient temperature of about 30°C in the WIPP repository horizon. 13

14 Figure G-3 summarizes U solubility data for schoepite (UO<sub>3</sub>•2H<sub>2</sub>O) in HClO<sub>4</sub> solutions at 25°C. 15 Krupka et al. (1985) obtained solubility data that indicate a decrease in the U concentration from 16 -2 to -5 log M as pH increased from 3 to 9. This trend was followed by an increase of similar 17 magnitude in the U concentration over the pH interval of 9 to 12. Bruno and Sandino (1989) 18 conducted solubility experiments with amorphous and crystalline UO<sub>2</sub>•2H<sub>2</sub>O, which show the 19 amorphous schoepite to be one to two orders of magnitude more soluble than the crystalline form. 20 Solubility studies for schoepite in saturated NaCl brine were not found. However, based on the 21 studies presented on Figure G-2 for UO<sub>2</sub>, it is expected that schoepite solubility in Salado brine 22 will be 1 to 2 orders of magnitude greater than the dilute solution data on Figure G-3. 23

### 4.0 NEPTUNIUM

28 The dominant valence states for Np in the natural environment are IV, V, and VI. As is the case 29 with U and Pu, Np solubilities are highly dependent on valence state. Np (IV) is expected to 30 dominate in the reducing repository environment, with solubility being controlled by crystalline 31 NpO<sub>2</sub>. Other forms of Np (IV) such as amprphous NpO<sub>2</sub>, NpO<sub>2</sub>•xH<sub>2</sub>O, and Np(OH)<sub>4</sub> will age to 32 crystalline NpO<sub>2</sub>. An important Np(V) solubility-controlling phase is NpO<sub>2</sub>OH.

34 Figure G-4 summarizes Np (IV) solubility data for NpO2 and NpO2\*xH2O in dilute solutions and 35 NaCl brines. The studies of Rai and Strickert (1980) and Rai et al. (1982) at 25°C show a 36 decrease in Np concentration from -5.5 to -6.5 log M as pH increases from about 2 to 6. The 37 data of Kim et al. (1985b) were obtained in 1M and 5M NaCl solutions at 20 to 25° C. The runs 38 at pH of 5 to 6 resulted in Np concentrations of about -4.5 log M, and those at a pH of 7.5 to 39 8 show a Np concentration of about -6 log M. Ionic strength does not appear to affect the 40 solubility of Np in these 1M and 5M runs, but a comparison of these data over the pH range of 5 to 6 with the data of Rai and Strickert (1980) suggests the solubility of NpO, is increased by 41 about 1.5 orders of magnitude in NaCl solutions of moderate to high ionic strength. 42

44 Pryke and Rees (1987) investigated the solubility of NpO<sub>2</sub>•xH<sub>2</sub>O in solutions equilibrated with 45 concrete at ambient temperature. Results on Figure G-4 show an apparent decrease in the Np concentration of about one-half log unit as the pH increase from 10 to 13. Comparing the studies 46 47 of Pryke and Rees (1987) and Rai and Strickert (1980), it appears that the data of Pryke and Rees (1987) anchor the projected trend of the data of Rai and Strickert (1980). 48

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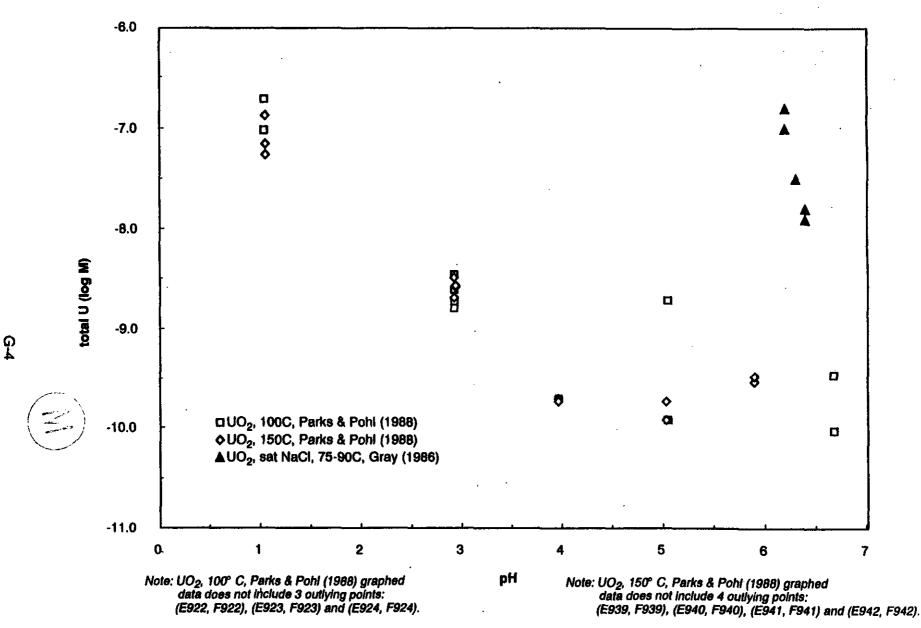
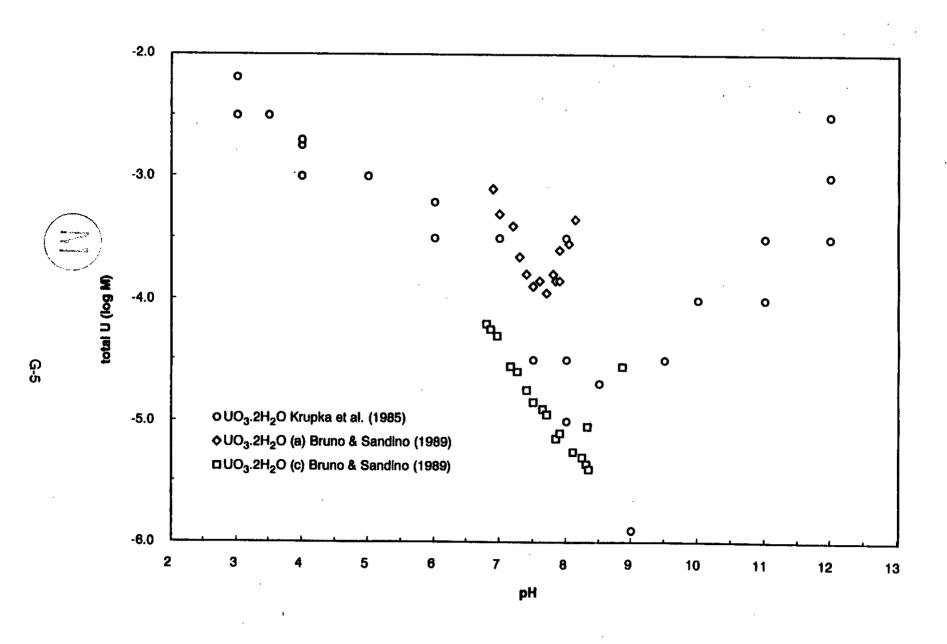


Figure G-2 UO<sub>2</sub> Solubility as a Function of pH for Dilute and Brine Solutions



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Figure G-3 UO<sub>3</sub>:2H<sub>2</sub>O Solubility as a Function of pH for Dilute Solutions

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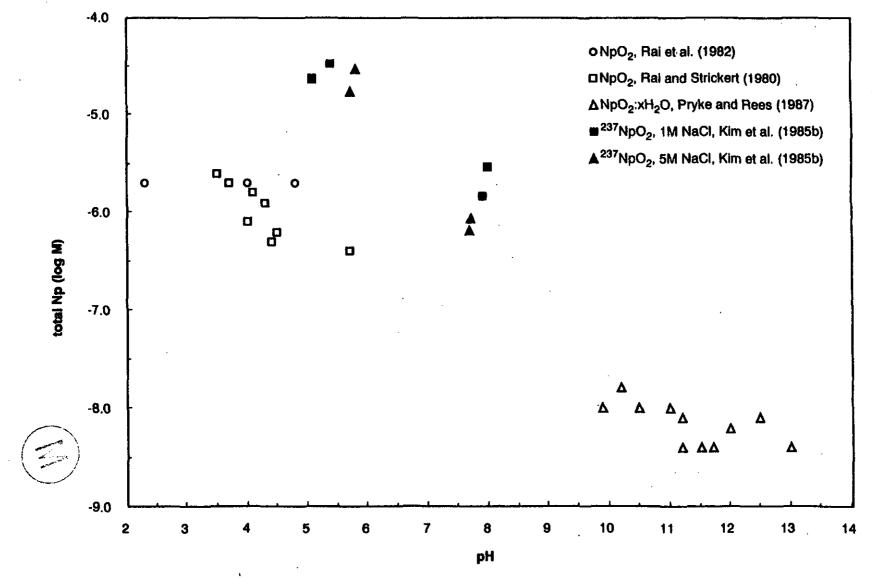


Figure G-4 NpO<sub>2</sub> Solubility as a Function of pH for Dilute, Saline, and Brine Solutions

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Results for Np (V) solubility studies are plotted on Figure G-5. Ewart et al. (1985) investigated 1 2 the solubility of NpO<sub>2</sub>OH in cement-equilibrated water. Results for this study illustrate a rapid 3 decrease in the Np concentration from about -5 to -9.5 log M between a pH of 9 to 13. Solubility 4 studies on NpO<sub>2</sub>OH in NaClO<sub>4</sub> and NaCl solutions were conducted by Kim et al. (1985b) at 20 5 to 25°C. Results for NpO<sub>2</sub>OH in 1M NaClO<sub>4</sub> indicate a decrease in the Np concentration from -2 6 to -6 log M over the pH interval 6 to 11, followed by increasing Np concentration over the pH 7 interval of 11 to 13. The solubility of NpO<sub>2</sub>OH in 1M and 5M NaCl solutions is about 2.5 orders 8 of magnitude lower at a pH of about 6.5, relative to the 1M NaClO<sub>4</sub> study. This suggests that Np 9 (V) may be reduced to Np (IV) in the NaCl solutions, resulting in solubility control by NpO<sub>2</sub> rather than NpO<sub>2</sub>OH. Additional solubility studies by Neck et al. (1992) with NpO<sub>2</sub>OH in dilute solution 10 and 1M and 3M NaClO<sub>4</sub> solutions indicate decreasing Np concentrations as pH increases from 11 about 7 to 11.5 followed by a rise in the Np concentration as pH increase to 14. In comparing 12 the dilute and 3M brine results of Neck et al. (1992), it is of interest that the 3M results indicate 13 NpO<sub>2</sub>OH solubility is about an order of magnitude lower in the brine relative to the dilute solution, 14 which is in contrast to results presented on Figure G-4 for NpO<sub>2</sub>. 15

#### 5.0 PLUTONIUM

Plutonium displays the most complex behavior of the five actinides of interest because of the four (III, IV, V, and VI) possible valence states. In a reducing environment, the solubility-controlling phases are probably Pu(OH)<sub>3</sub>, PuO<sub>2</sub>•xH<sub>2</sub>O, PuO<sub>2</sub>, or Pu(OH)<sub>4</sub>. Pu may be controlled in an oxidizing environment by PuO<sub>2</sub>(OH)<sub>2</sub>.

26 Figure G-6 summarizes Pu (III) solubility data. Rai et al. (1987) measured the Pu concentrations in deionized water and Permian Basin brines at 23°C in contact with amorphous <sup>239</sup>Pu(OH)<sub>3</sub>. 27 Results for runs with deionized water show a decrease in Pu concentration from about -3.5 to -10 28 log M as pH increases from 6 to 9, followed by a flat data trend between pH 9 and 13 that 29 indicates a Pu concentration of about -9.5 log M. A similar trend is observed for Pu concentration 30 31 in Permian Basin brine, although the Pu concentration appears slightly greater above a pH of 7 relative to the deionized water runs. Based on the measured pH value for the Permian Basin 32 brines, the solubility of <sup>239</sup>Pu(OH)<sub>3</sub> does not appear to be affected greatly by changes in ionic 33 strength of the solutions. However, Felmy et al. (1989) presented the preliminary data of Rai et 34 al. (1987) with pH values of the Permian Basin brines recalculated to account for the difference 35 36 in liquid junction potential between the solutions and standards. The recalculated pH values were one to two pH units greater than the measured values, which shifts the <sup>239</sup>Pu(OH)<sub>3</sub> sample points 37 in Figure G-6 to the right and suggests the amorphous hydroxide is two to three orders of 38 39 magnitude more soluble in the brines at the recalculated pH, relative to deionized water.

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Pu(OH)₄ solubility data for dilute solutions and a NaCl saturated brine are given on Figure G-7. 41 42 Ewart et al. (1985) investigated the solubility of Pu(OH)<sub>4</sub> in cement-equilibrated water over the pH 43 interval of 7 to 13. Their results show a decrease in Pu concentration from about -5.5 to -10.5 as pH increases to 12. Rai et al. (1980) presented results on the solubility of amorphous 44 45 <sup>239</sup>Pu(OH)<sub>4</sub> at 25°C that show Pu concentration decreases from about -4.5 to -7.5 log M as pH increases from 3 to 8. Flambard et al. (1986) conducted experiments on the solubility of Pu(OH), 46 47 in H<sub>2</sub>O saturated with NaCl at 23°C over a pH interval of 1 to 10. Their limited data set show no significant difference in solubility relative to data sets obtained with dilute solutions at a pH of 48 19 about 5. However, the comparison of the data sets at pH 10 indicates that the Pu concentration

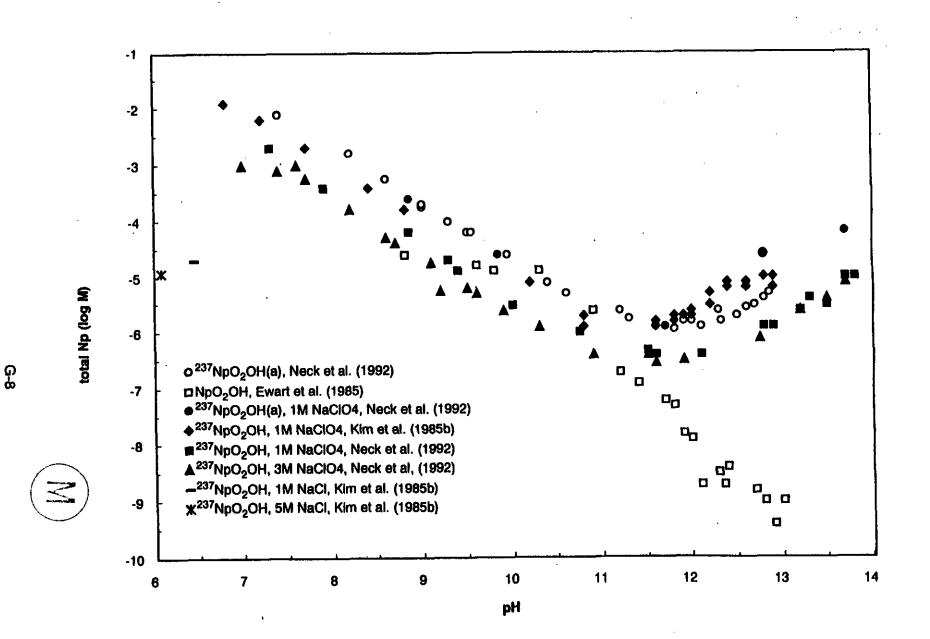


Figure G-5 NpO<sub>2</sub>OH Solubility as a Function of pH for Dilute, Saline, and Brine Solutions

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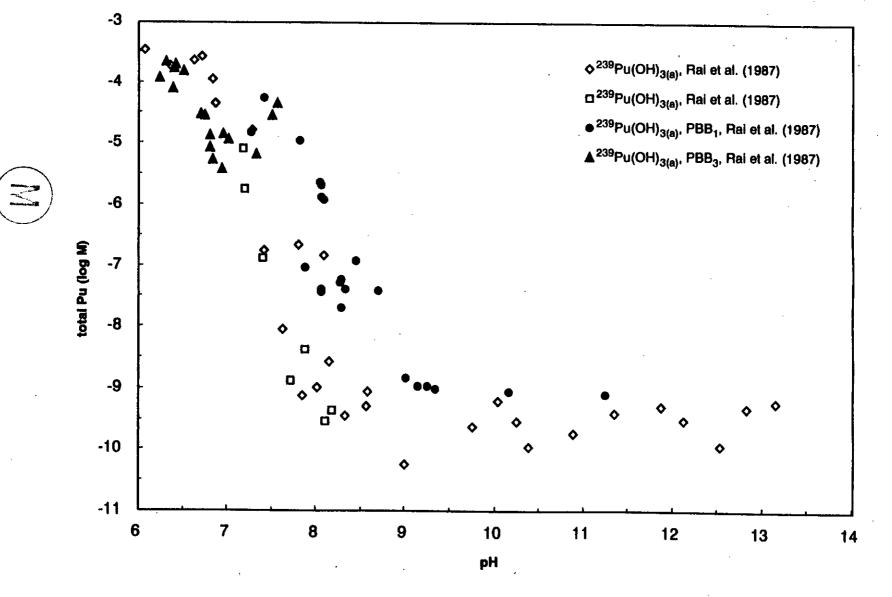


Figure G-6 Amorphous <sup>239</sup>Pu(OH)<sub>3</sub> Solubility as a Function of pH for Dilute Brine and Solutions

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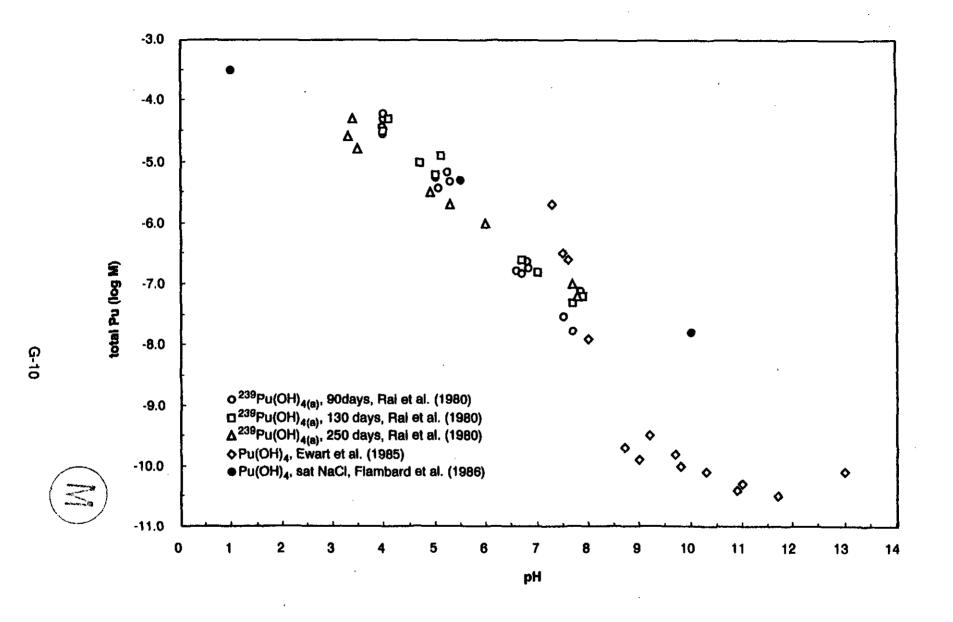


Figure G-7 Amorphous Pu(OH)<sub>4</sub> Solubility as a Function of pH for Dilute and Brine Solutions

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is about two orders of magnitude greater in the brine relative to the dilute solution used by Ewartet al. (1985).

4 Figure G-8 summarizes solubility studies carried out by Kim et al. (1985a) and Kim et al. (1985b) with <sup>238</sup>PuO<sub>2</sub> in dilute solutions and NaCl brines. The solubility of <sup>238</sup>PuO<sub>2</sub> in a 0.1M NaCl solution 5 6 decreases sharply from -5.5 to -7 log M over the pH interval of about 3 to 3.5, followed by an 7 apparent increase in Pu concentration to about -6 log M as the pH rises to 5.5. Data points for 8 the 3M and 5M NaCl brines indicate an increase in Pu concentration as pH increases. These 9 observed trends are the opposite of most actinide solubility trends, which show decreasing actinide concentrations with increasing pH. Kim et al. (1985a) attributed the enhanced solubility 10 to radiolysis effects and colloid formation. 11

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Solubility data for <sup>239</sup>PuO<sub>2</sub> are summarized on Figure G-9. The data reported by Rai et al. (1980) 13 on <sup>239</sup>PuO<sub>2</sub> solubility in dilute solutions shows a decrease in Pu concentration from approximately -14 5 to -9 log M as pH increases from about 3 to 8. Solubility data reported by Kim et al. (1985b) 15 for <sup>239</sup>PuO<sub>2</sub> follow a decreasing trend that is parallel to the data of Rai et al. (1980) but at Pu 16 concentrations that are one to two orders of magnitude lower over the pH interval of 4 to 6.5. The 17 large difference in the solubility of <sup>239</sup>PuO<sub>2</sub> obtained by these two independent studies may be due 18 to variation in the degree of crystallinity of the <sup>239</sup>PuO<sub>2</sub> solid used in the experiments. Additional 19 solubility studies with <sup>239</sup>PuO<sub>2</sub> were carried out by Kim et al. (1985b) using 5M NaCl solutions, and 20 these data plot below the dilute solution data obtained by Kim et al. (1985b) between pH 3.5 and 21 5 but then converge around a pH of 7. 22

Data on the solubility of PuO<sub>2</sub>•xH<sub>2</sub>O and <sup>238</sup>PuO<sub>2</sub>(OH)<sub>2</sub> in dilute solutions are summarized on 24 25 Figure G-10. Pryke and Rees (1987) examined the solubility of PuO<sub>2</sub>•xH<sub>2</sub>O in cement-equilibrated solutions adjusted to selected pH values with HCl. Their data show a sharp decrease in Pu 26 27 concentration from about -6 to -10 log M as pH increases from 7 to 9, followed by a shallow decrease as pH rises to 12. Solubility data for Pu (VI) was investigated by Kim et al. (1985b) 28 using <sup>238</sup>PuO<sub>2</sub>(OH)<sub>2</sub>. The data of Kim et al. (1985b) indicate a decrease in the Pu concentration 29 from about -4 to -8.5 as the pH increases from about 5.5 to 10. Above a pH of 10, the solubility 30 trend for <sup>238</sup>PuO<sub>2</sub>(OH)<sub>2</sub> shows a slight increase in Pu concentration. 31 32

### 6.0 AMERICIUM

Americium can be present in the natural environment in the III, IV, and V valence states. The valence state with the largest stability field is the III state.

Figure G-11 summarizes data on the solubility of  $Am(OH)_3$ . Rai et al. (1983) investigated the solubility of amorphous <sup>241</sup> $Am(OH)_3$  in dilute solutions adjusted with HCl or NaOH to set pH, and the solubility of amorphous <sup>243</sup> $Am(OH)_3$  in a pure H<sub>2</sub>O solution that had pH adjusted with HCl or tetrapropyl NH<sub>4</sub>OH. These data sets indicate a decrease in Am concentration from approximately -4 to -10 log M as the pH increases from about 7 to 10. Above a pH of 10, the trend of the plotted solubility points is essentially flat, and the Am concentration is maintained at around -10 log M.

Kim et al (1985b) examined the solubility of  $Am(OH)_3$  in a 0.1M NaClO<sub>4</sub> solution and their data follow a trend similar to the data of Rai et al. (1983), but for a given pH the solubility data of

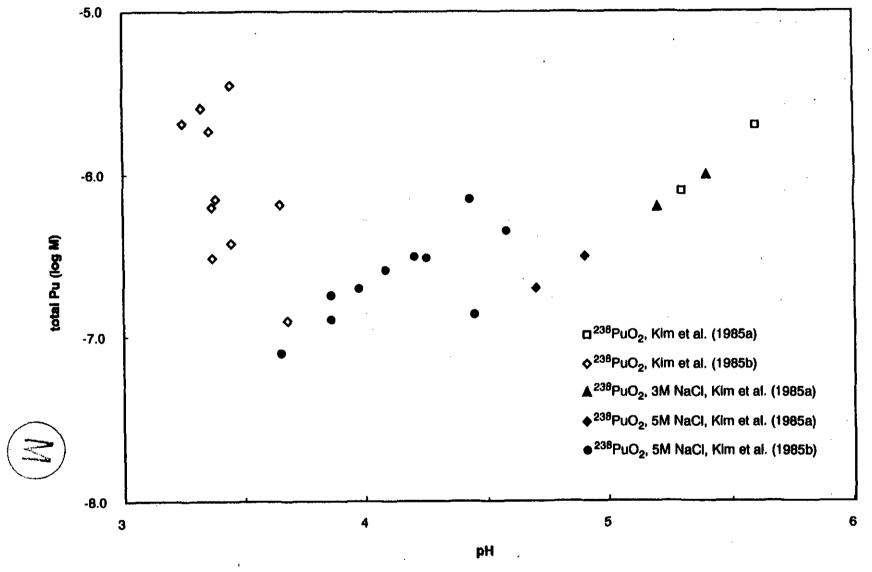


Figure G-8 <sup>238</sup>PuO<sub>2</sub> Solubility as a Function of pH for Dilute and Brine Solutions

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-5.0 □<sup>239</sup>PuO<sub>2(c)</sub>, 90 days, Rai et al. (1980)  $\sigma^{239}\text{PuO}_{2(c)}$ , 130 days, Rai et al. (1980) -6.0 Δ Ĥ  $\Delta^{239}\text{PuO}_{2(c)}$ , 250 days, Rai et al. (1980) 8 0 ▲<sup>239</sup>PuO<sub>2</sub>, 5M NaCl, Kim et al. (1985b) 0 Δ -7.0 0 a 0 total Pu (log M) \$ -8.0 0 00 G-13 o 🗖 ٥ -9.0 00 ¢ Ô -10.0 -11.0

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Figure G-9 <sup>239</sup>PuO<sub>2</sub> Solubility as a Function of pH for Dilute and Brine Solutions

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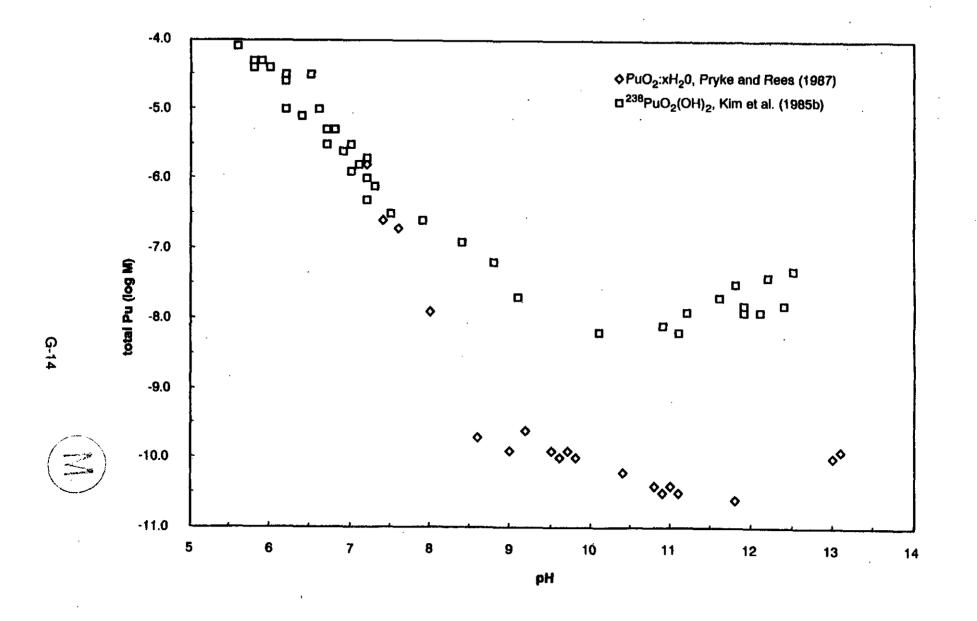


Figure G-10  $PuO_2 \cdot x H_2O$  and  $PuO_2$  (OH)<sub>2</sub> Solubilities as a Function of pH for Dilute Solutions

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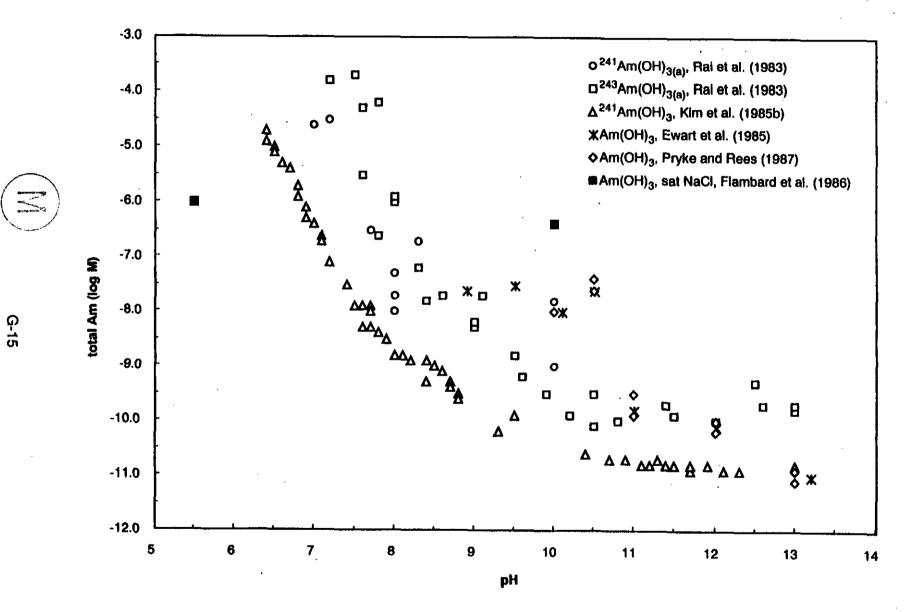


Figure G-11 Am(OH)<sub>3</sub> Solubility as a Function of pH for Dilute and Brine Solutions

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- 1 Kim et al. (1985b) are about 0.5 to 1 order of magnitude lower (Figure G-11). This may indicate 2 that the hydroxide used by Kim et al. (1985b) was aged to a microcrystalline form, relative to the 3 amorphous form used by Rai et al. (1983).
- 5 Ewart et al. (1985) investigated the solubility of  $Am(OH)_3$  in cement-equilibrated solutions and 6 their results show an abrupt decrease in the Am concentration from about -8 to -10 log 7 M between a pH of 10.5 to 11 (Figure G-11). The data of Pryke and Rees (1987) were also 8 obtained with cement-equilibrated solutions and their results closely follow the trend of data 9 reported by Ewart et al. (1985).
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Flambard et al. (1986) reported limited data on the solubility of Am(OH)<sub>3</sub> in a saturated NaCl solution (Figure G-11). Their two data points on Figure G-11 suggest a slight decrease in solubility as pH increases from 5.5 to 10. Based on their data point at a pH of 10, the solubility of Am(OH)<sub>3</sub> may be 1.5 to 3 orders of magnitude greater in saturated NaCl brines relative to dilute solutions.

- Figure G-12 summarizes solubility data for the Am (IV) and Am (V) solids  $AmO_2$ ,  $AmO_2OH$ , and AmOHCO<sub>3</sub>. Kim et al. (1985b) reported limited data on  $AmO_2$  in 0.5 and 5M NaCl solutions over the pH range of 3.5 to 5. The overlap of data point at a pH near 4 suggests that ionic strength does not have a strong effect on the solubility of  $AmO_2$  in this pH interval. Kim et al. (1985b) also looked at the solubility of  $AmO_2OH$  in 5M NaCl solution, and their results indicate a decrease in Am concentration from about -4 to -8 over the pH interval of 8 to 13.
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Solubility studies on amorphous  $AmOHCO_3$  carried out by Pryke and Rees (1987) show a decrease in Am concentration from about -4.5 to -7.5 as pH increases from 7 to 9.5 (Figure G-12). Similar studies carried out by Felmy et al. (1990) indicate significantly lower Am concentration of -8 to -8.5 log M over the pH range of 7 to 9, due to the aging of their precipitates to crystalline AmOHCO<sub>3</sub>. The convergence of these independent data sets at a pH near 9.5 is due to the instability of AmOHCO<sub>3</sub> above a pH of 9.5 as Am(OH)<sub>3</sub> becomes the stable phase.

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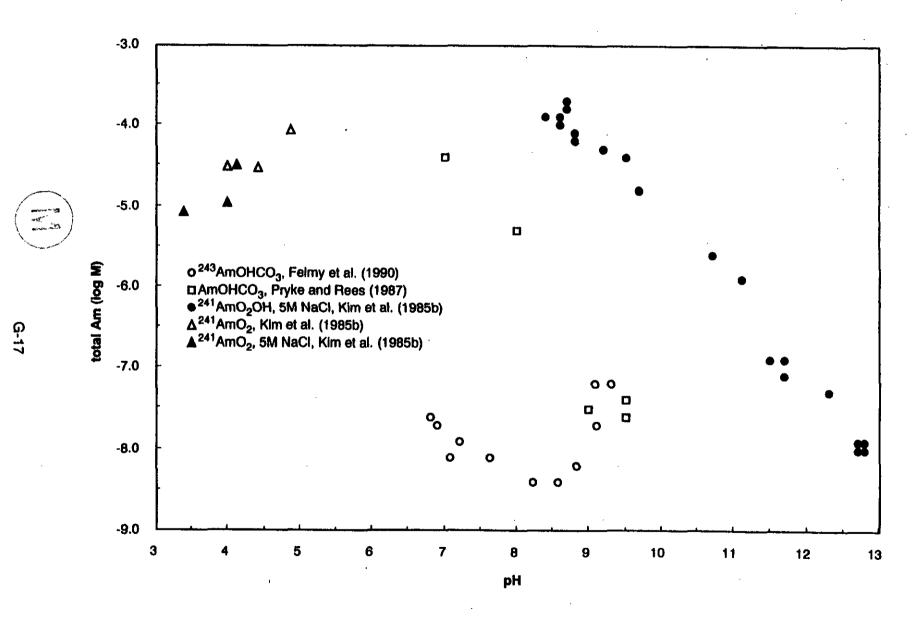


Figure G-12 AmOHCO<sub>3</sub>, AmO<sub>2</sub>OH, and AmO<sub>2</sub> Solubilities as a Function of pH for Dilute and Brine Solutions

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APPENDIX G ACTINIDE SOLUBILITY DATA BASE ATTACHMENT 1



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ACTINIDE	SOLID	SOLUTION COMPOSITION	SOLUTION	pН	SOLUBILITY	METHOD	EQlime	Eh (mV)	T (oC)	REFERENCE	NOTES
			DESCRIPTION	1	(log M)		(days)	or atm			
Am	amorphous 241am(oh)3	h2o+1.5E-3Mcacl2 + hcl or nach to adjust pH	dilute	7		oversaturation	7	air aim	22	Rai et al., 1983	1,2,6
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Am	amorphous 243am(oh)3	h2o + hcl or tetrapropyl nh4oh to adjust pH	dilute	7.8		oversaturation	26.2			+ <u></u>	
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Am	241am(oh)3	h2o + 0.1M nacio4	dilute	6.4		undersaturation		A ar atm	25	Kim et al., 1985b	1,17
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ACTINID	E SOLID	SOLUTION COMPOSITION	SOLUTION	pН	SOLUBILITY	METHOD	EQtime	Eh (mV)	T (oC)	REFERENCE	NOTES
	0440		DESCRIPTIC		(log M)		(days)	or atm			
Am	241am(oh)3	h2o + 0.1M nacio4	dilute	7,1	-6.7	undersaturation	NA	ar atm	25	Kim et al., 1985b	1,17
				7,2	-7.1	1		1			
				7.4	-7.5	-					
	}			7.5	-7.9	4		ľ			1
				7.6	7.9 -7.9	4					
				7.7		~		ł			
				7.6	-8.3	{	l	ł			1
	1			7.7	-8.3	4					
				7.6							
				7.9	-8.5	1	1	}		1	
				8		1	1				
				8.1							
				8.2	-8.9	1					
			1	8.4	-8.9	1					
				8.4	-9.3	· ·	ł				
				8.5	-9						
				8.6		1					
				8.7	-9.3	1					
	Ì			8.7	-9.4	1				1	
				8.8	-9.5	1					
				8.8		1				1	
				9.3	-10.2	1					ſ
				9.5	-9.9	1					t
	1			10.4	-10.6	1					
				10.7	-10.7						
				10.9	-10.7	1					
				11.1	-10.8						
	A the second second			11.1	-10.8	1					
				11.2	-10.8	]					
				11.3	-10.7	]					
	· · · · ·			11.4	-10.8	]				1	
				11.5						1	
				11.7	-10.9	]					
				11.7		]					
				11.9	-10.8	<u>.</u>					
				12.1	-10.9						
				12.3	-10.9			1			
Am	crystalline am(oh)3	h2o + 0.1M naclo4		13	-10.8	<u> </u>		ļ			
A00	CIASTERING SUICOULS	n20 + 0. IW INCO4	dilute	7	-4.3	calculated	NA	er atm	25	Sitva, 1984	_ [ _ 1
	1			8	-7	-					
	1			9	-8.2	4	1		1		1
Am	am(oh)3	h2o saturated with nacl	brine	10				—			
				<u> </u>	>-2.8	undersaturation	NA	4 N	IA 25	Flambard et al., 1986	4,10
				5.5	-6	4					1
Am	am(oh)3	cement-equilibrated water + hcl or nach	dilute	8.9		oversaturation	0.02				
			AND A	9.5			0.02	20	⊻  N#	Ewart et al., 1985	1,16
				10.1				[			
				10.1		1	1			1	
	1			11	-7.6	1	1			1	
				12	-9.8	1					
		1		13.2					1		
<u> </u>				13.2	T	<u>L</u>	I	L	F	F	1

### INDIX G ATTACHMENT #1

ACTINIDE	SOLID	SOLUTION COMPOSITION	SOLUTION	ρH	SOLUBILITY	METHOD	EOtima	Eh (mV)	T (0C)	REFERENCE	NOTES
	<u></u>		DESCRIPTION		(log M)			or aim	1		
Am	am(oh)3	deionized water equilibrated with crushed cement,	dilute	10	-8	oversaturation	0.02	200 mV in	ambient	Pryke and Reas, 1987	1, 21
		composition(M): ca+2=1E-2;		10.5	-7.4		{	n2 aim ai			
		cl-∞2E-3; so4-2∞3E-3; co3-2=3E-5; pH=12; pH adjusted with		10.6	-7.6	]		pH = 12			
		hcl or nach. I = 0.04 M	{ .	11	-9.5		}		1		
				11	-9.9						
				12	-10						
			, ·	13	-10.9			}	1		
				13	-11.1	<u> </u>					
Am	243amco3 (SB)	h2o + 0.01 M nahco3	dilute	6.8		oversaturation	66	10-3 atm	ambient	Felmy et al., 1990.	1,2
Į				6.89 7.08	-7.7			CO2 in Ar			
				7.21	-7.9	1	[				
				7.63	-8.1						
ļ			1	8.22	-8.4		1	1	]		
				8.83	-8.2						
	· · · · · · · · · · · · · · · · · · ·			9.09	-7.2	]	l	ļ		[	
i i			]	9.11	-7.7		1				·
Am	crystalline amohco3	h2o + 0.1M nacio4 + E-3.5atm co2	dilute	9.3	-7.2	calculated		ar+co2 atm		Silva, 1984	
	orystallino amonado			7					20	ONV8, 1904	7
4				8				1	1		
-				8.5	-9.3	4			J		
				9		4	l				
Am	crystalline amohco3	h2o + 0.1M naclo4 + 2E-3M co3	dilute	6	-6.3	calculated	N/	ar+co2 alm	25	Silva, 1984	
				7							
ļ			l	8			[				
			1	10			1				
Am	amohco3	deionized water equilibrated with crushed cement,	dilute	7		oversaturation	0.02	200 mV in	ambient	Pryke and Rees, 1987	1,21
ł		composition(M): ca+2=1E-2; na+=5E-5; mg+2=5E-6;	1		· · ·	4	· ·	n2 alm at	1		
1			1 .	8	•5.3	4	1	pH = 12			1
}		c1-=2E-3; so4-2=3E-3; co3-2=3E-5; pH=12; pH adjusted with		9	-7.5		i	µri = 12			
Į		hci or naoh. I ≖ 0.04 M	ſ	9.5	-7.4			j	1		
Am	241amo2oh	h2o + 5M nacl	brine	9.5 8.4	-7.6	undersaturated	+	ar atm		Kim et al., 1985b	
			Unite	8.6	•3.9		197		20	nim et al., 19855	1,17
l .				8.6	-4	1	1				
				8.7	-3.7						
				8.7	-3.8	4			ļ		ļ
[			1	8.8	4.2	1					
]				9.2	-4.3	1	1				
ļ		· ·		9.5	-4.4						
<b>I</b> .	· ·		1	9.7	-4.8 -5.6			Ĩ	1		
				11.1	-5.0	1		1	1		
L.			1	11.5	-6.9		[	l	1	1	

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ACTINIDE	SOLID	SOLUTION COMPOSITION	SOLUTION	pН	SOLUBILITY	METHOD	EQtime	Eh (mV)	T (oC)	REFERENCE	NOTES
			DESCRIPTION		(log M)		(days)	or atm			
Am	241amo2	h2o + 0.1M nacl	dilute	11.7	-6.9	undersaturated	160	ar atm	22	Kim et al., 1985b	4,20
	1			11.7	-7.1	4			ļ.		
	1		1	12.3	-7.3	4			{		
				12.7	-7.9	Į		ľ			1
	1			12.7	-8	4					
	1			12.8	-7.9					r	
	}			12.8	-8				1		
	1			4	-4.51		ŀ	1			ļ
				4.42	-4.53						
Am	241amo2	h2o + 5M nacl		4.68	-4.08						
	24101102	1120 + Om Haci	brine	3.39		undersaturated	160	ar atm	22	Kim et al., 1985b	4,20
				4.12	-4.49			:			
Ām	243am-doped PNL 76-68 glass	naci brine, WIPP brine B		3.99	-4.95		<u> </u>	l			
700	245811-00p85 FNL 76-05 gillss	Inact Dirite, THEFE DIRIE D	brine	NA		undersaturation		13.8MPa ar	150	Westsik et al., 1983	1,12,13,14
					-9.19		4	4			
	1				-8.65		8		]		
				l i	-8.94		16	4	1		
<b>A</b>	16 3 0 1 a strater and suited at 10 and a				-8.99		32	ļ	ļ		
Am	ILW solidilied with bitumen	h2o sat w/ca(oh)2,fe(ch)2,nacl,tbp,dbp,edta,cit&ox	brine	NA	-9.64		41			Marx and Keiling, 1989	4,18
Cm	244cm-doped PNL 76-68 glass	nacl brine, WIPP brine B	brine	NA	-10.03			13.8MPa ar	150	Westsik et al., 1983	1,12,13,14
				Į –	-9.99		8				ł
					-10		16				
A.I					-10.47		32				
Np	npo2:xh2o	deionized water equilibrated with crushed cement,	dilute	9.9	<u>-0</u>	oversaturation	1	-400 mV in	ambient	Pryke and Rees, 1987	1, 21
		composition(M): ca+2=1E-2; na+=5E-5; mg+2=5E-6;		10.2	-7.8			in n2 atm at		-	
		cl-=2E-3; so4-2=3E-3; co3-2=3E-5; pH=12; pH adjusted with				]		pH = 12			
				10.5	-8			}			
		hci or naoh. I = 0.04 M		11	-8	_		1		1	
				11.2	-8.1			1	i i		
				11.2	-8.4						
				11.5	-8.4		ļ				
				11.7	-8.4						
			i i	12			l		1		
				12.5	-8.1	]					
				13		[					
Np	237np-doped PNL 76-68 glass	nacl brine, WIPP brine B	brine	NA	-6.17	undersaturation	2	13.8MPa ar	150	Westsik et al., 1983	1,12,13,14
			i i		-6		4				
					-5.96	]	8				1
					-6.11		16	]			1
					-6.11	<u> </u>	32				
Np	237np-doped PNL 76-68 glass	h2o+1.5E-3Mcacl2+E-3Mquinhydrone + hcl or naoh	difute	6.8		undersaturation	5	296		Rai et al., 1982	1,2
			ł	6	-8.7	]	5	343	]		
				5.2	-6.3	]	5	391	1	1	
				3.9	-6.3	]	5		1	1	:
				2.8	-5.8	]	5		1		
				6.5	· -6.3	]	41	314		1	
				4.8	-6.1		41	414	1		
			1	3.8	-5.6	]	41	473		ł	1
				6.4	-6	]	67-83	320			1
			]	5.3	-6		67-83		-		
			1	4.3	-5.7		67-83	444	1		l l
	1	1	1	5.8	-5.7		288-302		1	1	

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ACTINIDE	SOLID	SOLUTION COMPOSITION	SOLUTION	pН	SOLUBILITY	METHOD	EQtime	Eh (mV)	T (oC)	REFERENCE	NOTES
<u> </u>			DESCRIPTION		(log M)		(days)	or atm			
Np	237np-doped PNL 76-66 glass	h2o+1.5E-3Mcacl2+E-3Mquinhydrone + hcl or nach	dilute	4.4		undersaturation		438	25	Rai et al., 1982	1,2
Np	237np-doped PNL 76-68 glass	h2o+1.5E-3Mcacl2+E-3Mquinhydrone + hcl or nach	dilute	3		undersaturation	NA	NA		Rai and Strickert, 1980	1,5
				3.2	-5.5				!		
				4.1	-6.1				1		
				4.8	•6.1						
				6.3	-6.7	1	1				1
				6.7	-6.8						
				6.8	-6.8						
Np	237npo2	block 1 SE ObtacalOvE Obtacalaturdayan a batan mark		6.9	·6.7	<u> </u>			ļ		
Nμ	2371102	h2o+1.5E-3Mcacl2+E-3Mquinhydrone + hcl or naoh	dilute	4.8		undersaturation	54	414	25	Rai et al., 1982	1,5
				4	-5.7	4		462			
Np	237npo2	hour tot of the set of the determined and the second		2.3	-5.7			562	Í		
цяф	12371102	h2o+1.6E-3Mcacl2+E-3Mquinhydrone + hcl or nach	dilute	3.5		undersaturation	NA	NA NA	NA NA	Rai and Strickert, 1980	1,5
				3.7	-5.7		Í	1			
				4	-6.1				1		
				4.1	-5.8				1		
				4.3	-5.9				1		
				4.4	-6.3	-			{		
				4.5	-6.2				1		
Np	237npo2	h2o + 1M nacl		5.7	-6.4						
lub.	zampoz	HZU + IM HACE	saline	5.4		undersaturation		ar atm	25	Kim et al., 1985b	4,20
			1	5.08	-4.63	4	118				
	1			7.91	-5.83	4	72				
Np	237npo2	h2o + 5M nacl		7.99	-5.54	<u> </u>	72	<b></b>	<u> </u>		
111	2011poz		brine .	5.82		undersaturation		ar alm	25	Kim et al., 1985b	4,20
				5.72	-4.77		118	4	1		
				7.69	<u>-6.19</u> -6.07		72 72	4	1		
Np	npo2oh	cement-equilibrated water + hcl or nach	dilute	8.8		oversaturation	/2				
				9.6	-4.8		•	200	IN P	Ewart et al., 1985	1,16
				9.8	-4.8						
				10.3	-4.9	{			1		
				10.9	-4.5	-			í I		
				11.2	-6.7					[	
				11.4	-6.9						t i
			1	11.7	-7.2	1		]			
				11.8	-7.3	4					1
			· ·	11.9	-7.8			1			
				12	.7.9			1			
				12.1	-8.7			]			
				12.3	-8.5						
				12.4	-8.7	1				Į	
				12.4	·8.4	1			Į.	1	
				12.7	-8.8	1					1
				12.8	-9	1					
	1			12.9	-9.4	1			l		j l
				13	-9					1	
Np Np	npo2oh	h2o sat w/ ca(oh)2, fe(oh)2 and nacl	brine	NA		undersaturation	NA	NA	NA	Marx and Kelling, 1989	4,18
Np	npo2oh	h2o sat w/ ca(oh)2, fs(oh)2, nacl and TBP	brine	NA		undersaturation	NA			Marx and Keiling, 1989	4,18
Np	npo2oh	h2o sat w/ ca(oh)2, fe(oh)2, nacl and DBP	brine	NA		undersaturation	NA			Marx and Kelling, 1989	4,18
Np	npo2oh	h2o sat w/ ca(oh)2, fe(oh)2, nacl and EDTA	brine	NA	-3.76	undersaturation	NA		NA	Marx and Keiling, 1989	4,10
Np	npo2oh	h2o sat w/ ca(oh)2, fe(oh)2, nacl and citrate	brine	NA	-3.14	undersaturation	NA	NA	NA	Marx and Keiling, 1989	4,18
Np	npo2oh	h2o sat w/ ca(oh)2, fe(oh)2, nacl and oxalate	brine	NA		undersaturation	NA	NA		Marx and Kelling, 1989	4,18

Mp         237rpo20h         h20 + 1M naclo4         DESCRIPTION (bg M)         (bg M)         (digyg) or atm 72         All 22           72         2.21         -1.0         undersaturation (0.2         N/A at atm           84         -3.40         undersaturation (0.2         N/A         at atm           10.2         -6.11         undersaturation (0.2         N/A         at atm           10.2         -6.11         -0.2         -0.11         -0.12           10.2         -6.11         -0.2         -0.11         -0.12           10.2         -6.11         -0.2         -0.11         -0.2           11.9         -5.2         -11.9         -5.2         -11.9           12.2         -6.3         -12.2         -6.3         -12.2           12.2         -6.3         -12.2         -6.3         -12.2           12.2         -6.3         -12.2         -6.3         -12.2           12.2         -6.3         -12.2         -6.3         -12.2         -6.3           12.2         -6.3         -12.2         -6.3         -12.2         -6.3           12.2         -6.3         -12.2         -6.3         -12.2         -6.3 <tr< th=""><th>OC) REFERENCE NOT</th><th>OTES</th></tr<>	OC) REFERENCE NOT	OTES
Np         B37pp20h         h2o + 1M naclo4         seline         6.8         1.8         Max         MA ar elm           7.7         4.2         7.7         4.2         6.4         4.4         6.8         3.8           6.0         3.8         3.8         3.8         3.8         3.8         3.8           10.0         6.7         1.0         6.6         1.6         3.8         3.8           10.0         6.7         1.0         6.7         1.0         6.7         1.0           11.0         6.8         1.1         6.7         1.1         6.7         1.1         6.7           11.0         6.7         1.2         6.7         1.2         6.7         1.2         6.7           12.4         6.1         1.2         6.7         1.2         6.7         1.2         6.7           12.8         6.8         1.2         4.8         1.1		UIES
No         237ps2bh         B0 - 1M rad         saile         6.4         3.6           10.8         5.6         11.6         5.6           11.6         5.6         11.6         5.6           11.6         5.6         11.6         5.6           11.6         5.6         11.6         5.6           11.6         5.6         11.6         5.6           11.6         5.6         11.6         5.6           12.2         5.6         12.2         5.6           12.2         5.6         12.2         5.6           12.2         5.6         12.2         5.6           12.2         5.6         12.2         5.6           12.2         5.6         12.2         5.6           12.2         5.6         12.2         5.6           12.2         5.6         12.2         5.6           12.2         5.6         12.2         5.6           12.2         5.6         12.2         5.6           12.2         5.6         12.2         5.6           12.2         5.6         12.2         5.6           12.2         5.6         12.2         5.6     <	25 Kim et al., 1985b	1,1
Np         237rpo20h         h20 + IM nacl         seline         6.41         4.51           10         237rpo20h         h20 + IM nacl         seline         6.44         4.51           12         4.51         12.8         5.1         12.8         5.1           12.8         5.2         12.4         6.51         12.4         6.51           12.4         5.51         12.4         6.51         12.4         6.51           12.9         -5.2         12.4         6.51         12.4         6.51           12.8         -5.1         12.8         -5.1         12.8         -5.1           12.9         -5.2         12.8         -5.1         12.8         -5.1           12.9         -5.2         12.8         -5.1         12.8         -5.1           12.9         -5.2         12.8         -5.1         12.8         -5.1           12.9         -5.2         12.8         -5.1         12.8         -5.1           12.9         -5.2         12.8         -5.1         12.8         -5.1           12.8         -5.2         12.8         -5.1         12.8         -5.1           12.9         -5.2	20 ((11) 81 21., 19000	۰.
Np         237pp30h         RD + IM rad         sale         10.2         4.3           Np         237pp30h         RD + IM rad         sale         1.4         4.4         1.4           Np         237pp30h         RD + IM rad         sale         1.22         4.51           12.2         4.51         1.18         5.50         1.18         5.51           12.2         4.51         1.12         4.51         1.12         4.51           12.2         4.51         1.12         4.51         1.12         4.51           12.4         4.52         1.12         4.51         1.14         4.52           12.4         4.52         1.12         4.51         1.14         4.52           12.4         4.52         1.12         4.51         1.14         4.52           12.4         4.52         1.12         4.51         1.12         4.51           12.6         4.51         1.04         4.21         0rdersaturation         1.4         at atm           Np         237pp32h (amorphous)         p.237, 10-30mg disolved as npo2ciol in 0.1M naciod         60/4         2.42         0rdersaturation         1.2         at atm           13.3		
Np         227npo2ch         h20 + 1M nacl         6all nacl         6all nacl         6all nacl           Np         227npo2ch         h20 + 1M nacl         6all nacl         6all nacl         6all nacl           Np         227npo2ch         h20 + 1M nacl         6all nacl         6all nacl         6all nacl           Np         227npo2ch         h20 + 1M nacl         6all nacl         6all nacl         6all nacl           Np         227npo2ch         h20 + 1M nacl         6all nacl         6all nacl         6all nacl           Np         227npo2ch         h20 + 1M nacl         6all nacl         6all nacl         6all nacl           Np         227npo2ch         h20 + 1M nacl         6all nacl         6all nacl         6all nacl           Np         227npo2ch         h20 + 1M nacl         6all nacl         6all nacl         14 ar arm           Np         237npo2ch (amorphous)         np237.10-30mg disached as npo2cloid in 0.1M nacloid         8all nacl         12 ar arm           Np         237npo2ch (amorphous)         np237.10-30mg disached as npo2cloid in 0.1M nacloid         8all nacl         3all nacl           Np         237np3ch (amorphous)         np237.10-30mg disached as npo2cloid in 0.1M nacloid         14 ar arm         14 ar arm           <		
No         237no20h         No. + 1M nacl         saline         6.44         4.51           No         237no20h         No. + 1M nacl         saline         6.44         4.51           No         237no20h         No. + 1M nacl         saline         6.44         4.51           No         237no20h         No. + 1M nacl         saline         6.44         4.51           No         237no20h         No. + 1M nacl         saline         6.44         4.51           No         237no20h         No. + 1M nacl         saline         6.44         4.51           No         237no20h         No. + 1M nacl         saline         6.44         4.51           No         237no20h         No. + 1M nacl         saline         6.44         4.51           No         237no20h         No. + 1M nacl         saline         6.44         4.51           No         237no20h (amorphous)         mp2.97.10-30mg disactived as npo2ciol in 0.1M naclo4         bine         6.07         4.21         lowersturation         14 ar atm           No         237no20h (amorphous)         mp2.97.10-30mg disactived as npo2ciol in 0.1M naclo4         6.42         2.88         4.81           No. 4.31         6.32         4.31		
Np         237np020h         h00 + 1M nacl         saline         6.44         4.72         Indersekuration         14 ar atm           Np         237np020h         h00 + 1M nacl         saline         6.44         4.72         Indersekuration         14 ar atm           Np         237np020h         h00 + 1M nacl         saline         6.44         4.72         Indersekuration         14 ar atm           Np         237np020h         h00 + 1M nacl         saline         6.44         4.72         Indersekuration         14 ar atm           Np         237np020h         h00 + 1M nacl         saline         6.44         4.72         Indersekuration         14 ar atm           Np         237np020h         h00 + 1M nacl         saline         6.44         4.72         Indersekuration         14 ar atm           Np         237np020h         h00 + 1M nacl         saline         6.44         4.72         Indersekuration         14 ar atm           Np         237np020h (amorphous)         np237,10-30mg dissolved as npp2cto4 in 0.1M naclo4         64/4         4.72         Indersekuration         14 ar atm           0.6         5.32         9         3.73         9         3.74         9         3.75         9         3.75		
Np         237pp020h         hb0 + 1M add         saline         6.44         -4.7         undersaturation         14 ar atm.           Np         237pp020h         hb0 + 1M add         saline         6.44         -4.7         undersaturation         14 ar atm.           Np         237pp020h         hb0 + 1M add         saline         6.44         -4.7         undersaturation         14 ar atm.           Np         237pp020h         hb0 + 1M add         saline         6.44         -4.7         undersaturation         14 ar atm.           Np         237pp020h         hb2 + 50 ft nacd         bf/me         6.07         -4.81         undersaturation         14 ar atm.           Np         237pp020h (amorphous)         np237,10-30mg dissolved as np020iol in 0.1M naclo4         dilute         7.4         -2.1         oversaturation         14 ar atm.           Np         237np020h (amorphous)         np237,10-30mg dissolved as np020iol in 0.1M naclo4         dilute         7.4         -2.1         oversaturation         14 ar atm.           Np         237np020h (amorphous)         np237,10-30mg dissolved as np020iol in 0.1M naclo4         dilute         7.4         -2.1         oversaturation         14 ar atm.           Np         237np020h (amorphous)         np237,10-30mg di		
Np         237npo20h         h20 + 1M nacl         100         52           Np         237npo20h         h20 + 1M nacl         52         52           Np         237npo20h         h20 + 1M nacl         52         52           Np         237npo20h         h20 + 1M nacl         50         12         63           12.8         -6         12.9         -6         12.9         -6           12.9         -6         12.9         -6         12.9         -6           12.9         -6         12.9         -6         12.9         -6           12.9         -6         12.9         -6         12.9         -6           12.9         -6         12.9         -6         12.9         -6           12.9         -6         12.9         -6         12.9         -6           12.9         -6         12.9         -6         12.9         -6           12.9         -6         12.9         -6         12.9         -6           12.9         -6         12.9         -6         12.9         -6           12.9         -6         12.9         -6         12.9         -7           9.37		
Np.         237pog2oh         h20 + 1M nacl         saline         6.0         12.8         5.0           Np.         237pog2oh         h20 + 1M nacl         saline         6.0         12.8         5.0           Np.         237pog2oh         h20 + 1M nacl         saline         6.0         12.8         5.0           Np.         237pog2oh         h20 + 1M nacl         saline         6.07         4.01         undersaturation         14 ar atm           Np.         237pog2oh         h20 + 5M nacl         bh119         6.07         4.01         undersaturation         14 ar atm           Np.         237pog2oh (amorphous)         np237,10-30mg dissolved as npo2clo4 in 0.1M naclo4         Ofute         7.4         2.1         oversaturation         14 ar atm           Np.         237pog2oh (amorphous)         np237,10-30mg dissolved as npo2clo4 in 0.1M naclo4         Ofute         7.4         2.1         oversaturation         12 ar atm           Np         237pog2oh (amorphous)         np237,10-30mg dissolved as npo2clo4 in 0.1M naclo4         Ofute         7.4         2.1         oversaturation         12 ar atm           0.6         -3.26         -3.75         -3.75         -3.75         -3.75         -3.75         -3.75         -3.75         <		
Np         237npo2oh         h2o + 1M nacl         saline         6.47         -4.91         undersaturation         14 ar atm           Np         237npo2oh         h2o + 1M nacl         saline         6.44         -4.91         undersaturation         14 ar atm           Np         237npo2oh         h2o + 1M nacl         saline         6.44         -4.91         undersaturation         14 ar atm           Np         237npo2oh         h2o + 5M nacl         brine         6.07         -4.91         undersaturation         14 ar atm           Np         237npo2oh         h2o + 5M nacl         brine         6.07         -4.91         undersaturation         14 ar atm           Np         237npo2oh (amorphous)         np237,10-30mg dissolved as npo2clo4 in 0.1M naclo4         52         -2.8         -2.8         -2.8         -2.9		
Np         237npo2oh         h2o + 1M nacl         saline         6.6         12         6.6           12         6.6         12         6.6         12         6.6           12.24         6.6.1         12.4         6.6.1         12.4         6.6.1           12.6         5.2         12.6         5.2         12.6         5.2           12.9         -5         12.9         -5         12.9         -5           12.9         -5         12.9         -5         12.9         -5           12.9         -5         12.9         -5         12.9         -5           12.9         -5         12.9         -5         12.9         -5           12.9         -5         12.9         -5         12.9         -5           12.9         -5         12.9         -5         12.9         -5         12.9         -5         12.9         -5         12.9         -5         12.9         -5         12.9         -5         12.9         -5         12.9         -5         12.9         -5         12.9         -5         12.3         -5.6         12.4         -6.1         12.4         12.4         12.4         12.4		
Np         237ps220h         h20 + 1M nacl         saline         6.44         -6.7           12.2         -6.5         -1.2         -6.6         -1.2         -6.6           12.4         -6.5.2         -1.2         -6.6         -1.2         -6.6           12.4         -6.5.2         -1.2         -6.6         -1.2         -7.6         -7.6         -7.6         -7.6         -7.6         -7.6         -7.6         -7.6         -7.6         -7.6         -7.6         -7.6         -7.6         -7.6         -7.6         -7.6         -7.6         -7.6		
Np         237npo2ch         h20 + 1M nacl         sellne         6.4         4.6           Np         237npo2ch         h20 + 1M nacl         sellne         6.4         4.7           Np         237npo2ch         h20 + 1M nacl         sellne         6.4         4.7           Np         237npo2ch         h20 + 50 + 1M nacl         sellne         6.4         4.7           Np         237npo2ch         h20 + 50 + 1M nacl         sellne         6.4         4.7           Np         237npo2ch         h20 + 50 + 1M nacl         sellne         6.4         4.7           Np         237npo2ch         h20 + 50 + 1M nacl         brine         6.4         4.7           Np         237npo2ch         h20 + 50 + 1M nacl         brine         6.4         4.7           Np         237npo2ch         h20 + 50 + 50 + 50 + 50 + 50 + 50 + 50 +		
Np         237npo2oh         h20 + 1M nacl         saline         6.41         4.71           Np         237npo2oh         h20 + 1M nacl         saline         6.44         4.71           Np         237npo2oh         h20 + 1M nacl         saline         6.44         4.71           Np         237npo2oh         h20 + 5M nacl         brins         6.07         4.91         undersaturation         14 ar atm           Np         237npo2oh         h20 + 5M nacl         brins         6.07         4.91         undersaturation         14 ar atm           Np         237npo2oh (amorphous)         np237,10-30mg dissolved as npo2clo4 in 0.1M naclo4         diule         7.4         2.1         oversaturation         14 ar atm           Np         237npo2oh (amorphous)         np237,10-30mg dissolved as npo2clo4 in 0.1M naclo4         diule         7.4         2.1         oversaturation         1.2 ar atm           Np         237npo2oh (amorphous)         np237,10-30mg dissolved as npo2clo4 in 0.1M naclo4         diule         7.4         2.1         oversaturation         1.2 ar atm           Np         237npo2oh (amorphous)         np237,10-30mg dissolved as npo2clo4 in 0.1M naclo4         diule         5.3         1.2         5.6           9         3.75		
Np         237npo2oh         h2o + 1M naci         seline         6.44         -6.1           12.8         -5         12.8         -5         12.8         -5           12.9         -5.2         12.8         -5         12.8         -5           12.9         -5.2         12.8         -5         12.8         -5           12.9         -5.2         12.8         -5         12.8         -5           12.9         -5.2         12.8         -4.7         undersaturation         14 at atm           Np         237npo2oh         h2o + 5M naci         brine         6.07         -4.91         undersaturation         14 at atm           Np         237npo2oh         h2o + 5M naci         brine         6.07         -4.91         oversaturation         14 at atm           Np         237npo2oh (amorphous)         np237.10-30mg dissolved as npo2clo4 in 0.1M naclo4         dilute         7.4         -2.1         oversaturation         1-2 at atm           0         -3.7         -9.3         -4         -9.5         -4.2         9.95         -4.6           10.4         -5.1         10.6         -5.3         -11.8         -5.9         -11.8         -5.9         -11.8		
Np         237npo2oh         h2o + 1M naci         seline         6.44         -6.1           12.8         -5         12.8         -5         12.8         -5           12.9         -5.2         12.8         -5         12.8         -5           12.9         -5.2         12.8         -5         12.8         -5           12.9         -5.2         12.8         -5         12.8         -5           12.9         -5.2         12.8         -4.7         undersaturation         14 at atm           Np         237npo2oh         h2o + 5M naci         brine         6.07         -4.91         undersaturation         14 at atm           Np         237npo2oh         h2o + 5M naci         brine         6.07         -4.91         oversaturation         14 at atm           Np         237npo2oh (amorphous)         np237.10-30mg dissolved as npo2clo4 in 0.1M naclo4         dilute         7.4         -2.1         oversaturation         1-2 at atm           0         -3.7         -9.3         -4         -9.5         -4.2         9.95         -4.6           10.4         -5.1         10.6         -5.3         -11.8         -5.9         -11.8         -5.9         -11.8		
Np         237npo2oh         h2o + 1M nacl         saline         6.44         -5.1           Np         237npo2oh         h2o + 1M nacl         saline         6.44         -5.2           12.8         -5.6         -12.9         -5.2         -12.8         -5.6           12.9         -5.2         -12.8         -5.6         -12.9         -5.2           12.9         -5.2         -12.8         -6.6         -12.9         -6.2           Np         237npo2oh         h2o + 1M nacl         saline         6.44         -4.7         undersaturation         14 ar atm           Np         237npo2oh         h2o + 5M nacl         brine         6.07         -4.91         undersaturation         14 ar atm           Np         237npo2oh (amorphous)         np237,10-30mg dissolved as npo2clo4 in 0.1M naclo4         diule         7.4         2.1         oversaturation         1-2 ar atm           8.6         -3.25         9         -3.75         9         -3.75         9         -3.75         -9         -3.75         -9         -3.75         -9         -3.75         -9         -3.75         -9         -3.75         -9         -3.75         -9         -3.75         -9         -3.75 <td< td=""><td></td><td></td></td<>		
Np         237npo2oh         h2o + IM naci         saline         6.44         4.7         undersaturation         14 ar atm           Np         237npo2oh         h2o + IM naci         saline         6.44         4.7         undersaturation         14 ar atm           Np         237npo2oh         h2o + 5M naci         brine         6.07         4.91         undersaturation         14 ar atm           Np         237npo2oh         h2o + 5M naci         brine         6.07         4.91         undersaturation         14 ar atm           Np         237npo2oh (amorphous)         np237,10:30mg dissolved as npo2clo4 in 0.1M nacio4         diule         7.4         2.2         2.8           9         -3.75         9         -3.75         9         -3.75           9         -3.75         9         -3.75         9         -3.75           9         -3.75         9         -3.75         -9         -3.75           9         -3.75         -9         -3.75         -9         -3.75           9         -3.75         -9         -3.75         -9         -3.75           9         -3.75         -9         -3.76         -9         -3.75           11.8		
Np         237npo2oh         h2o + 1M naci         saline         6.2         12.6         5.2         12.8         4.6           Np         237npo2oh         h2o + 1M naci         saline         6.44         -4.7         undersaturation         14 ar atm           Np         237npo2oh         h2o + 5M naci         br/ne         6.07         4.81         undersaturation         14 ar atm           Np         237npo2oh         h2o + 5M naci         br/ne         6.07         4.91         undersaturation         14 ar atm           Np         237npo2oh (amorphous)         np237,10-30mg dissolved as npo2cto4 in 0.1M naclo4         br/ne         6.07         4.91         undersaturation         14 ar atm           Np         237npo2oh (amorphous)         np237,10-30mg dissolved as npo2cto4 in 0.1M naclo4         dilute         7.4         9.3         -4           9.3         -4         9.55         -4.2         9.55         -4.2         -9.55         -4.6         10.06         -5.3         11.2         -5.6         11.9         -5.96         11.9         -5.96         11.9         -5.96         11.9         -5.96         11.9         -5.96         11.9         -5.66         12.1         -5.66         12.1         -5.66		
ND         237npo2oh         h2o + 1M naci         sealine         6.44         4.7         undetsaturation         14 ar atm           Np         237npo2oh         h2o + 6M naci         sealine         6.44         4.7         undetsaturation         14 ar atm           Np         237npo2oh         h2o + 6M naci         sealine         6.44         4.7         undetsaturation         14 ar atm           Np         237npo2oh         h2o + 6M naci         brine         6.07         4.91         undetsaturation         14 ar atm           Np         237npo2oh (amorphous)         np237,10-30mg dissolved as npo2clo4 in 0.1M naclo4         dilute         7.4         2.1         oversaturation         1-2 ar atm           8.6         -3.25         9         -3.75         9         -3.75         9         -3.75         9         -3.75         9         -3.75         9         -3.75         9         -3.75         -9         -3.75         -9         -3.75         -9         -3.75         -9         -3.75         -9         -3.75         -9         -3.75         -9         -3.75         -9         -3.75         -9         -3.75         -9         -3.75         -9         -3.75         -9         -3.75 <t< td=""><td></td><td></td></t<>		
Np         237npo2oh         h2o + 1M nacl         ealine         6.44         -4.7         undersaturation         14 ar atm           Np         237npo2oh         h2o + 5M nacl         br/ne         6.07         -4.91         undersaturation         14 ar atm           Np         237npo2oh         h2o + 5M nacl         br/ne         6.07         -4.91         undersaturation         14 ar atm           Np         237npo2oh (amorphous)         np237,10-30mg dissolved as npo2cto4 in 0.1M naclo4         br/ne         6.07         -4.91         undersaturation         14 ar atm           Np         237npo2oh (amorphous)         np237,10-30mg dissolved as npo2cto4 in 0.1M naclo4         ditute         7.4         -2.1         oversaturation         1-28 ar atm           8.2         2.8         -3.75         -9         -3.75         -9         -3.75         -9         -3.75         -9         -3.75         -9         -4.21         -9.95         -4.22         -9.95         -4.22         -9.95         -4.22         -9.95         -4.22         -9.95         -4.22         -9.95         -4.21         -9.95         -4.22         -9.95         -4.21         -9.95         -1.13         -5.76         -11.8         -5.76         -11.8         -5.76	1	
Np         237npo20h         h2o + 1M nacl         saline         6.47         4.61         undersaturation         14         ar atm           Np         237npo20h         h2o + 5M nacl         bring         6.07         4.61         undersaturation         14         ar atm           Np         237npo20h         h2o + 5M nacl         bring         6.07         4.61         undersaturation         14         ar atm           Np         237npo20h (amorphous)         np237.10-30mg dissolved as npo2clo4 in 0.1M naclo4         dibite         7.4         2.1         oversaturation         14         ar atm           Np         237npo2oh (amorphous)         np237.10-30mg dissolved as npo2clo4 in 0.1M naclo4         dibite         7.4         2.1         oversaturation         1-2 ar atm           8.6         -3.25         -9         -3.77         -9.3         -4         -6.2         -2.8         -8.6         -2.6         -2.8         -8.6         -2.6         -2.8         -9         -3.77         -9.3         -4         -6.2         -2.8         -2.8         -6         -2.6         -2.8         -2.8         -2.8         -2.8         -2.8         -2.8         -2.8         -2.8         -2.8         -2.8         -2.8 <td< td=""><td></td><td></td></td<>		
Np         237npo2oh         h2o + 1M naci         saline         6.44         -6.1           Np         237npo2oh         h2o + 5M naci         brine         6.07         4.91         undersaturation         14 ar atm           Np         237npo2oh         h2o + 5M naci         brine         6.07         4.91         undersaturation         14 ar atm           Np         237npo2oh (amorphous)         np237,10-30mg dissolved as npo2clo4 in 0.1M naclo4         ditule         7.4         2.1         oversaturation         14 ar atm           Np         237npo2oh (amorphous)         np237,10-30mg dissolved as npo2clo4 in 0.1M naclo4         ditule         7.4         2.1         oversaturation         1.2 ar atm           Np         237npo2oh (amorphous)         np237,10-30mg dissolved as npo2clo4 in 0.1M naclo4         ditule         7.4         2.1         oversaturation         1.2 ar atm           Np         237npo2oh (amorphous)         np237,10-30mg dissolved as npo2clo4 in 0.1M naclo4         ditule         7.4         2.1         0           Np         3.7         9.3         -4         9.55         4.2         9.95         4.2           9.95         -4.2         9.95         -4.2         9.95         1.1.3         5.76         11.0		
Np         237npo2oh         h2o + IM nacl         saline         6.44         4.7         undersaturation         14 ar atm           Np         237npo2oh         h2o + 5M nacl         brine         6.44         4.7         undersaturation         14 ar atm           Np         237npo2oh         h2o + 5M nacl         brine         6.07         4.91         undersaturation         14 ar atm           Np         237npo2oh (amorphous)         np237,10-30mg dissolved as npo2clo4 in 0.1M naclo4         dilute         7.4         -2.1         oversaturation         1-2 ar atm           Np         237npo2oh (amorphous)         np237,10-30mg dissolved as npo2clo4 in 0.1M naclo4         dilute         7.4         -2.1         oversaturation         1-2 ar atm           0.5         -4.2         9.55         -4.2         9.55         -4.2         9.55         -4.2         9.55         -4.2         9.95         -4.6         10.4         -5.1         10.6         -5.9         11.3         -5.75         11.6         -5.9         11.8         -5.86         11.9         -5.86         11.9         -5.86         11.2         -5.6         11.2         -5.6         11.2         -5.6         11.2         -5.6         12.1         -5.6         12.1		
Np         237npo2oh         h2o + 1M naci         saline         6.44         -4.7         undersaturation         14 ar atm           Np         237npo2oh         h2o + 5M naci         brine         6.07         4.91         undersaturation         14 ar atm           Np         237npo2oh (amorphous)         np237,10-30mg dissolved as npo2clo4 in 0.1M naclo4         dilute         7.4         -2.1         oversaturation         1-2 er atm           8.6         -3.25         9         -3.75         9.3         -4         -4.2         9.55         -4.2         9.95         -4.6         -1.2         9.95         -4.6         -1.2         9.95         -4.6         -1.2         -2.6         -1.2         er atm         -1.2         -1.2         -1.2         -1.2         -1.2         -1.2         -1.1         -1.2         -1.1         -1.2         -1.2         -1		
Np         237npo2oh         h2o + 1M nacl         saline         6.44         -4.7         undersaturation         14         ar atm           Np         237npo2oh         h2o + 5M nacl         br/ne         6.07         4.91         undersaturation         14         ar atm           Np         237npo2oh         h2o + 5M nacl         br/ne         6.07         4.91         undersaturation         14         ar atm           Np         237npo2oh (amorphous)         np237.10-30mg dissolved as npo2clo4 in 0.1M naclo4         dilute         7.4         -2.1         oversaturation         1-2         ar atm           9         -3.71         -9.3         -4         -4.2         -9.5         -4.2         -9.55         -4.2         -9.55         -4.2         -9.55         -4.2         -9.55         -4.2         -9.55         -4.2         -9.55         -4.2         -9.55         -4.2         -9.55         -4.2         -9.55         -4.2         -9.55         -4.1         -1.2         -6.6         -11.3         -5.75         -11.6         -5.3         -11.2         -5.6         -11.3         -5.75         -11.6         -5.6         -11.2         -5.6         -11.2         -5.6         -11.2         -5.6         -11		
Np         237npo2oh         h2o + 5M naci         brine         6.07         4.91         undersaturation         14         ar atm           Np         237npo2oh (amorphous)         np237.10-30mg dissolved as npo2clo4 in 0.1M nacko4         dilute         7.4         2.1         oversaturation         1-2 ar atm           8.2         2.8         8.6         -3.25         9         -3.75         9         -3.75         9         -3.75         9         -3.75         9         -3.75         9         -3.75         9         -3.75         9         -3.75         -9         -3.75         -9         -3.75         -9         -5         -4.21         9.95         -4.61         -10.4         -5.1         -10.6         -5.3         -11.2         -5.66         -11.3         -5.75         -11.6         -5.9         -11.8         -5.95         -11.8         -5.95         -11.8         -5.9         -11.8         -5.8         -11.8         -5.8         -11.8         -5.8         -11.2         -5.8         -11.2         -5.8         -11.2         -5.8         -11.2         -5.8         -11.2         -5.8         -11.2         -5.8         -11.2         -5.8         -11.2         -5.8         -11.2         -5.8	22 Kim et al., 1995b	A -
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	22 Kim et al., 1985b	4,
8.2         2.8           8.6         -3.25           9         -3.7           9.3         -4           9.5         -4.2           9.55         -4.2           9.55         -4.2           9.55         -4.2           9.55         -4.2           9.55         -4.2           9.55         -4.2           9.55         -4.2           9.55         -4.2           9.55         -4.2           9.55         -4.2           9.55         -4.2           9.55         -4.2           9.55         -4.2           9.55         -4.2           9.55         -4.2           9.55         -4.2           9.55         -4.2           9.55         -4.2           9.55         -1.2           9.12         -5.9           11.8         -5.9           11.9         -5.8           12.1         -5.9           12.3         -5.6	25 Neck et al., 1992	1,2
8.6         -3.25           9         -3.75           9.3.7         9.3           9.5         -4           9.5         -4.2           9.55         -4.2           9.95         -4.6           10.4         -5.1           10.6         -5.3           11.2         -5.6           11.3         -5.75           11.8         -5.95           11.9         -6.8           12.1         -5.9           12.3         -5.6	20 HOCK OF BI., 1332	1,1
9         -3.75           9         -3.7           9.3         -4           9.5         -4.2           9.55         -4.2           9.95         -4.6           10.4         -5.1           10.4         -5.1           11.3         -5.75           11.8         -5.95           11.8         -5.95           12         -5.8           12.1         -5.9           12.3         -5.6		
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$		
9.3         -4           9.5         -4.2           9.55         -4.2           9.95         -4.6           10.4         -5.1           10.6         -5.3           11.2         -5.6           11.3         -5.75           11.8         -5.95           11.9         -5.8           12.1         -5.9           12.3         -5.6		
$ \begin{array}{c}             9.5 & -4.2 \\             9.55 & -4.2 \\             9.95 & -4.6 \\             10.4 & -5.1 \\             10.6 & -5.3 \\             11.2 & -5.6 \\             11.3 & -5.75 \\             11.6 & -5.9 \\             11.8 & -5.95 \\             11.9 & -5.8 \\             12 & -5.8 \\             12 & -5.8 \\             12 & -5.6 \\             12.3 & -5.6 \\         \end{array} $		
$ \begin{array}{c} 9.55 & -4.2 \\ 9.95 & -4.6 \\ 10.4 & -5.1 \\ 10.6 & -5.3 \\ 11.2 & -5.6 \\ 11.3 & -5.75 \\ 11.6 & -5.9 \\ 11.8 & -5.95 \\ 11.9 & -5.8 \\ 12 & -5.8 \\ 12 & -5.8 \\ 12.3 & -5.6 \\ \end{array} $		
9.95         -4.8           10.4         -5.1           10.6         -5.3           11.2         -5.6           11.3         -5.75           11.6         -5.9           11.8         -5.95           11.9         -5.8           12         -5.8           12.3         -5.6		
10.4         -5.1           10.6         -5.3           11.2         -5.6           11.3         -5.75           11.6         -5.9           11.8         -5.95           11.9         -5.88           12         -5.88           12.3         -5.6		
10.6         -5.3           11.2         -5.6           11.3         -5.75           11.6         -5.9           11.8         -5.95           11.9         -5.8           12         -5.8           12         -5.9           12.3         -5.6		
11.2         -5.6           11.3         -5.75           11.6         -5.9           11.8         -5.95           11.9         -5.8           12         -5.8           12.3         -5.6		
11.3         -5.75           11.6         -5.9           11.8         -5.95           11.9         -6.8           12         -5.9           12.1         -5.9           12.3         -5.6		
11.6         -5.9           11.8         -5.95           11.9         -6.8           12         -5.9           12.1         -5.9           12.3         -5.6		
11.8         -5.95           11.9         -6.8           12         -5.9           12.1         -5.9           12.3         -5.6		
11.9 -5.8 12 -5.9 12.1 -5.9 12.3 -5.6		
12 -5.8 12.1 -5.9 12.3 -5.6		
12.1 -5.9 12.3 -5.6	l l	
12.3 -5.6		
12.3 -5.6		
12.3 -5.8		
12.5 -5.7		
12.6		
12.7 -5.5	1 l	
12.8 -5.4		
12.9 -5.3		

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ACTINIDE	SOLID	SOLUTION COMPOSITION	SOLUTION	ρH	SOLUBILITY	METHOD	FOlime	Eh (mV)	T (oC)	REFERENCE	NOTES
			DESCRIPTION	<u>r</u>	(log M)		(days)	or atm	1 (00)	ner enenve	NOIES
Np	237npo2oh (amorphous)	np237,10-30mg dissolved as npo2cto4 in 1.0M naclo4	saline	8.85		oversaturation	1-2	ar atm	25	Neck et al., 1992	1,20
				9.85	-4.6	1	ļ		Į.		
				11.7	-5.9 -4.2	ł	ł				
Np	237npo2oh (aged, grev-white ppt)	np237,10-30mg dissolved as npo2clo4 in 1.0M naclo4	saline	7.3		oversaturation	14.28	ar alm	25	Neck et al., 1992	1,20
			Junio	7.9	-3.4		14-20	a ann	25	NOCK OL 81., 1992	1,20
				8.85	-4.2	1		1			
				9.3	-4.7	}	1	1	1		1
				9.4	-4.9	4	1				
		·		10 10.8	-6.5						1
				11.5	-6.33						
				11.6	-6.4	1	l		1		ţ
		•		12.1	-6.4						
				12.8	-5.9	]					
				12.9	-5.9 -5.6	4					
				13.2 13.3	-5.0	4					1
			l	13.5	-5.5	-	ļ	ļ		l T	ł
				13.7	-5	7	1				
				13.8	-5		$\square$	L			
Np	237npo2on (aged, grey-white ppt)	np237,10-30mg dissolved as npo2clo4 in 3.0M naclo4	brine	7	-3	oversaturation	14-28	ar atm	25	Nøck el al., 1992	1,20
				7.4	-3.1						
				7.7	-3.25	4	1		Î		
				8.2	-3.8	7					
				8.6	-4.3						
				8.7	-4.4	4					1
				9.1	-4.75		l	l	1		
				9.2 9.5	-5.25						
				9.6	-5.3	1					
				9.9	-5.6	· ·					
				10.3	-5.9	]					
				10.9	-6.4		ļ	ļ		ļ	
				11.5	-6.4 -6.55						
				11.9	-0.05						
				12.8	-6.1	1					
		•		13.2	-5.6						
				13.5	-5.4		}	1	1		1
Pu	puo2:xh2o	deionized water equilibrated with crushed coment,		13.7	-5.1			<u> </u>			
	PUCE ATTEV		dilute	7.2	-5.8	oversaturation	0.02	-300 mV in	ambient	Pryke and Rees, 1987	1,21
		composition(M): ca+2=1E-2; na+=5E-5; mg+2=5E-6;		7.4	-6.6		1	ar/5%h2 aim			
		cl-=2E-3; 804-2=3E-3; c03-2=3E-5; pH=12; pH adjusted with		[		1	l	at pH = 12	1	[	
				7.6	-6.7	2					
	1	hct or naoh. I = 0.04 M		8			1				
				8.6					1		
				<u>9</u>			ļ				
			l	9.5			ļ		ļ	ļ	
			L	9.6							

ACTINIDE	SOLID	SOLUTION COMPOSITION	SOLUTION	pН	SOLUBILITY	METHOD	EQtime	Eh (mV)	T (oC)	REFERENCE	NOTES
			DESCRIPTION		(log M)			or atm			
Pu	puo2:xh2o	deionized water equilibrated with crushed cement,	ditute	9.7	-9.9	oversaturation	0.02	+300 mV in	ambient	Pryke and Rees, 1987	1,2
	1	composition(M): ca+2=1E-2; na+=5E-5; mg+2=5E-6;		9.6	-10		ł	ar/5%h2 alm	l		
		cl-=2E-3; so4-2=3E-3; co3-2=3E-5; pH=12; pH adjusted with		10.4	-10.2	]		at pH = 12			
		hcl or naoh. 1 = 0.04 M		10.8	-10.4	1	ļ	· ·			
				10.9	-10.5	1					
				11	-10.4	1					
				11.1	-10.5	1					
				11.8	-10.6	1	l .				
				13	-10	1					1
				13.1	-9.9	1					
Pu	239pu-doped PNL 76-68 glass	nacl brine, WIPP brine B	brine	NA		undersaturation		13.8MPa ar	150	Westsik et al., 1983	1 10 10 1
			Dime	NA			_	13.0MPa ar	150	VV85151K 81 at., 1983	1,12,13,1
	1					4	4			1	
	Į.			NA			8		1	1	- 1 · ·
				NA		4	16	1			
Pu			·	NA			32				
۳U	amorphous 239pu(oh)3	h2o + hcl or nach to adjust pH	dilute	7.85		oversaturation	8			Rai et al., 1987	2,
				8.14	-8.57	1	12	-359			1
				10	-9.21		12			Î .	
				6.57	-9.05		12			]	
	1		,	8.32	-9.45		13	-283		4	
				8.99	-10.23		13				
				10.2	-9.54		13				
				10.4	-9.95	1	13			]	
				10.9	•9.73	1	13				
		· ·		11.4	-9.39	1	13			)	
			· ·	11.9	-9.29	1	13	-293	-		
				12.1		ł		-293	-		
					-9.52	4	13				
			[	12.5	-9.93		13				
				12.8	-9.31	1	13				
				13.2	-9.23		13		1		
				7.63	-8.04	]	22	-340			
				6.08	-3.46		2	-185			
				6.36	-3.73		2	-256			
				7.41	-6.74		2		1		
				6.71	-3.56	1	2			l	1
		,		6.86	-4.33		7	-294	1		
			[	6.83	-3.95	1	7	-355			
				6.62	-3.64	1	8				
				7.8	-6.68	1	8				
				8.08	-6.83	1 ·	8		1		
				7.28	-4.77		8		-		
				9.76	-9.61	ł		-202	{		
				8.01	-8.99	{	10		4		1
						4	24	-238			1
Pu	amorphous 239pu(oh)3	h2o + hcl or naoh to adjust pH		8.56	-9.28	·	24	-295	L		
Γ <b>U</b>	anoiphous zospu(on)o	nzo + aci or naon to adjust pri	dílute	7.19		undersaturation	21			Rai et al., 1987	2,
	1	1	1	7.18	-5.09	à	21	-314		1	
	ł			7.4	-6.88	Į	21	-310		ł	
				7.71	-8.88	J	21	-305	ł		
			· ·	7.87	-8.37		21	-322	]		
	1		1	8.18	-9.36	]	21	-330	1		
			]	8.1	-9.54	]	21	-327	1	1	
Pu	amorphous 239pu(oh)3	PBB1 + hcl or naoh to adjust pH	brine	7.26	-4.83	oversaturation	3			Rai et al., 1987	- 2,
	1			8.06	-5.87	1	3				<u>،</u> ک

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ACTINIDE	SOLID	SOLUTION COMPOSITION	SOLUTION	pН	SOLUBILITY	METHOD	EQtime	Eh (mV)	T (oC)	REFERENCE	NOTES
			DESCRIPTIO		(log M)		(days)	or atm			
Pu	amorphous 239pu(oh)3	PBB1 + hcl or nach to adjust pH	brine	7.41		oversaturation	7		23	Rai et al., 1987	2,4
				7.82	-4.94	1	7				
1				8.04	-5.64	4	7				
				8.05	-5.68	{	7				
Į				<u>B.45</u>	-6.93		7				i 1
				<u>8.7</u> 9.01	•7.4	4	7		-		
				9.34	-8.84	4	7		4		
ļ				10.2	-9.06	4	7				·
				11.3	-9.09	4	7		4	l .	
1				8.08	-5.91	-	14		4		
Pu	amorphous 239pu(oh)3	PBB1 + hcl or nach to adjust pH	brine	7.88		undersaturation	13			Fial et al., 1987	
	······		5	8.28	-7.23		19			rial et al., 1987	2,4
1				8.28	-7.68	1	19				
				8.06	-7.39	{	19			1	1 1
				8.05	-7.42		19				
				8.32	-7.36		19		-		
1				8.26	-7.28	1	19		1		
				9.15	-8.97		19		-		1 1
Į –			1	9.25	-8.97	1	19				
Pu	amorphous 239pu(oh)3	PBB3 + hcl or nach to adjust pH	ibrine	6.32		oversaturation	3			Ral et al., 1987	2,4,11
				6.5	-3.82		3			11ai et al., 1997	2,4,11
			,	8.41	-3.7		8	-287	1	1	
	$\sim$			8.4	-3.77		8		{		
1				6.24	-3.93		8		-		
1				6.95	-4.85	1	8		1		
				7.01	-4.92	1	8		1		
				7.5	-4.53	1	8		1		
l l				7.57	-4.34	1	8		1	1	1 1
				6.39	-4.09		10				
				6.8	-4.87	1	10		1		
Pu	amorphous 239pu(oh)3	PBB3 + hcl or nach to adjust pH	brine	6.7	-4.52	undersaturation	14		23	Rai et al., 1987	2,4,11
				6.75	-4.53	]		-302	1		
<u>}</u>				6.61	-5.05		]	-367	1		
1				6.83	-5.25	1		-303	1		
				6.94	+5.42			-303	1		
			<u> </u>	7.32	-5.18		i	-307			
Pu	298puo2	h2o+0.1Mnacl pH adjusted with hno3?	dilute	5.3	-6.1	undersaturation	120	air atm	25	Kim et al., 1985a	1,7
}				5.6	-5.7		210		1		
Pu	238puo2	h2o+0.5Mnacl pH adjusted with hno3?	saline	5.7		undersaturation	120	air atm	25	Kim et al., 1985a	1,7
				5.9	-5.5		210				ŕ
Pu	238puo2	h2o+1Mnacl pH adjusted with hno3?	saline	5.4	-5.9	undersaturation	120	air atm	25	Kim et al., 1985a	1,7
			l	5.7	-5.7		210		]		
Pu	238puo2	h2o+3Mnacl pH adjusted with hno3?	brine	5.2	-6,2	undersaturation	120	air atm	25	Kim et al., 1985a	1,7
				5.4	-6		210				
Pu	238puo2	h2o+5Mnacl pH adjusted with hno3?	brine	4.7		undersaturation		airatm	25	Kim et al., 1985a	1,7
<b>D</b>				4.9	-6.5	L	210				
Pu	238puo2	h2o+ 0.1Mnaci	dilute	3.25		undersaturation	120	ar atm	21	Kim et al., 1985b	4,20
1				3.37	-6.51	1	1		1	1	
				3.45	-5.45	l .		1			1
				3.45	-6.42	l í		1			
l		(		3.37	-6.2	4	ļ	1	1	1	1 1
L	L			3.33	-5.59	<u> </u>	I	L			1 1

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ACTINIDE	SOLID	SOLUTION COMPOSITION	SOLUTION	pН	SOLUBILITY	METHOD	EQtime	Eh (mV)	T (oC)	REFERENCE	NOTES
	· · · · · · · · · · · · · · · · · · ·		DESCRIPTION		(log M)			or atm			
Pu	238puo2	h2o+ 0.1Mnacl	dilute	3.68	-6.9	undersaturation	120	ar atm	21	Kim et al., 1985b	4,20
				3.36	-5.73						
				3.65	-6.18						
				3.39	-6.15			·			
Pu	238puo2	h2o+5Mnacl	brine	3.65		undersaturation	120	ar aim	22	Kim et al., 1985b	4,20
	)		1	3.86	-6.74		ł				
	1		1	3.97	-8.7						
	1			4.2	-6.5						
			1	3.86	-6.69						l
			1	4.25	-8.51		Ì	1			
				4.43	-6.15				}		
				4.08	-6.59	4	1		1		
				4.58	·6.35						
				4.45	-6.86		L				
Pu	239puo2	h2o+0.1Mnacl pH adjusted with hno3?	dilute	2.48	-8.8	undersaturation	250	air aim		Kim et al., 1985a	1,7
Pu	239puo2	h2o+0.5Mnaci pH adjusted with hno3?	saline	2.8		undersaturation		air aim		Kim et al., 1985a	1,7
Pu	239puo2	h2o+1Mnacl pH adjusted with hno3?	saline	2.7		undersaturation		air aim		Kim et al., 1985a	1.7
Pu	239puo2	h2o+3Mnacl pH adjusted with hno3?	brine	2.2		undersaturation		air atm		Kim et al., 1985a	1,7
Pu	239puo2	h2o+5Mnacl pH adjusted with hno3?	brine	2.2		undersaturation		air aim		Kim et al., 1985a	1,7
Pu	239puo2	h2o+ 0.1M nacl	dilute	3.97		undersaturation	250	ar aim	21	Kim et al., 1985b	4,20
	1			3.94	-7.83						
	1			4.51	-8.4	4					
				4.46	-8.4		1				
	l .		1	4.94	-8.7		}	1		1	
				5.69	-9.6						
				4.85	-9.3						
				4.95	-9.34						
				6.63	<u>•10,1</u>		l ·	l	ł		1
Pu	239puo2	h2o+5Mnacl		5.51	-9.6						
Pu	239002	NZG+DMNBCI	brine	3.76		undersaturation	250	ar atm	24	Kim et al., 1985b	4,20
	1			3.72	·8.47			1			
				3.85	-8.95						
			(	3.58	-8.58		Į.	ł			1
				4.31	-9.48			1			
			1	4.42	-9.51 -8.98			ł			
				3.84	-8.86			F			
	1			6.49	-10.5						
			<b>\</b>	6.44	-10.8		1	1.	1		1
Pu	239puo2(c)	h2o+0.0015Mcacl2	dilute	3.8		undersaturation		air aim			
	200000000	ALOTO OUT ONCOUL	Gildte	3.8	-6.05		90	all Barri	25	Rai et al., 1980	4,5
				4.3	-0.05 -6.57			1			
			ļ	4.3	-6.44		ł	Į –	4	{	4
	]			5.4	-7.29						
				5.45	-7.47			1			
		· ·		7.3	-8.55						
				7.3	-8.78						
Pu	239puo2(c)	h2o+0.0015Mcacl2	dilute	3.4		undersaturation	120	air atm	20	Rai et al., 1980	
	1			3.6	-6.3		'30		20	1 101 CL 21., 190V	1,15
	-			3.6	-6.4		1				ł
				4	-6.5			[			
				3.9		1		l	1		Į
	l		1	5.7			1	1		1	1

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### )NDIX G

ACTINIDE	SOLID	SOLUTION COMPOSITION	SOLUTION	pН	SOLUBILITY	METHOD	EQtime	Eh (mV)	T (oC)	REFERENCE	NOTES
			DESCRIPTION		(log M)			or atm	<u> /</u>		
Pu	239puo2(c)	h2o+0.0015Mcacl2	dilute	7.2	-8.6	undersaturation		air atm	25	Rai et al., 1980	1,1
				7.7	-8.3						
Pu	239puo2(c)	h2o+0.0015Mcacl2	dilute	3		undersaturation	250	air aim	25	Rai et al., 1980	1,1
	İ.			3.2	·5.7		1.				1
				3.3	-5.9	1	1			1	
				4	-6		1		1		ſ
				6.2	-6.8	1					
Pu	freshly declad spent fuel	PBB1	brine	NA	-8.5	undersaturation	5	jair atm	25-30	Gray, 1986	1,2,
				NA	-8.6		5	1			.,_,
				NA	•8.7	1	14	1			
				NA	-8.8	7	14	7			
				NA	-8.8	1	28	1			
				NA	-8.9		28	1			1
			1	NA	-8.8		60	1			
				NA	-8.9		60	1			
Pu	previously declad spent fuel	PBB1	brine	NA	-7.4	undersaturation		air aim	25-30	Gray, 1986	1,2,
				NA			5	1			
				NA	-7.8	1	14	1			4
				NA	-7.7	1	28	1			- L
				NA	-8.3	1	28	1			
				NA	-7.5	1	60	1			
				NA	-8.3		60	1	1	1	1
		1		NA	-7.5	1	90	1	1	1	
				NA	-8.4		120				
				NA	-7.2	1	180		1	1	1
	1			NA	•7.6		180		}		
Pu	ILW solidified with bitumen	h2o sat w/ca(oh)2,fe(oh)2,nacl,tbp,dbp,edta,cit&ox	brine	NA	-9.13	undersaturation	41	N/	NA	Marx and Keiling, 1989	4,18
Pu	pu(oh)4	h2o saturated w/ ca(oh)2, le(oh)2 and naci	brine	NA		undersaturation	NA			Marx and Keiling, 1989	4,1
Pu	pu(oh)4	h2o saturated w/ ca(oh)2, fa(oh)2, nacl and TBP	brine	NA	•7.8	undersaturation	NA			Manx and Kelling, 1989	4,1
	pu(oh)4	h2o saturated w/ ca(oh)2, fe(oh)2, nacl and DBP	brine	NA	-6.8	undersaturation	NA			Marx and Keiling, 1989	4,1
	pu(oh)4	h2o saturated w/ ca(oh)2, fe(oh)2, nacl and EDTA	brine	NA	-5	undersaturation	NA	NA		Marx and Kelling, 1989	4,1
Pu	pu(oh)4	h2o saturated w/ ca(oh)2, fe(oh)2, nacl and citrate	brine	NA	-4.9	undersaturation	NA	NA		Marx and Keiling, 1989	4,10
Pu	pu(oh)4	h2o saturated w/ ca(oh)2, fe(oh)2, nacl and oxalate	brine	NA	-6.4	undersaturation	NA	N/		Marx and Keiling, 1989	4,1
Pu	pu(oh)4	h2o saturated with naci	brine	1	-3.5	undersaturation	NA			Flambard et al., 1986	4,1
				5.5	-5.3	1		1		,	
				10	-7.8		1	1	1	1	)
Pu	239pu(oh)4(a)	h2o+0.0015Mcaci2	dilute	3.95	-4.44	undersaturation	90	air atm	25	Rai et al., 1980	4,1
	1			4	-4.54	1	1		1		1
				4	-4.31						
				4	-4.22		[	1			
				5	-5.25		ļ	ļ	{	ļ	
	]			5.05	5.44				1	ſ	
				5.25	-5.17				1		ł
				5.3	-5.31		Î		1		
				6,6	·6.77						
	1		1			4	]	1			
						-		1			
			1						1	1	
	ł		1		.7 77	1			1	1	
							ł				1
				6.6 6.7 6.8 6.83 7.5 7.7 7.7	-6.83 -6.63 -6.63 -7.54 -7.54 -7.77 -7.11						

ACTINIDE	SOLID	SOLUTION COMPOSITION	SOLUTION	pН	SOLUBILITY	METHOD	EQtime	Eh (mV)	T (0C)	REFERENCE	NOTES
			DESCRIPTION	·	(log M)		(days)	or alm			
Pu	239pu(oh)4(a)	h2o+0.0015Mcacl2	dilute	4		undersaturation	130	air atm	25	Rai et al., 1980	1,15
				4.1	-4.3	j					1
				4.7	-5						
				-6	-5.2						
				5.1	-4.9						
				6.7	-6.6	]					
				7	-6.8	]	l	l	ł		
	1		1	7.7	-7.3	]			1		
				7,9	-7.2			·			
Pu	239pu(oh)4(a)	h2o+0.0015Mcaci2	dilute	3.3		undersaturation	250	air alm	25	Rai et al., 1980	1,15
				3.4	-4.3				1		
				3.5	-4.8						
				4.9	-5.5	]					
				5.3	-5.7	]					
				6	-6						
	4			7.7	-7		1	1	1	1	1
				7.8	•7.2	]					1
Pu	pu(oh)4	cement-equilibrated water + hcl or nach	dilute	7.3	-5.7	oversaluration	0.02	-300	) NA	Ewart et al., 1985	1,16
	1			7.5	-6.5						
				7.6	-6.6	]	·	-			
	-			8	-7.9	]		:			
				8.7	-9.7	1					
	( ***** )			9	-9.9	7					
l				9.2	-9.5	1	{	4	1	1	1
				9.7	.9.8		1				
				9.8	-10	1					
			1	10.3	-10.1	1					
	ł			10.9	-10.4	1					
ļ				11	-10.3	1					1
	1			11.7	-10.5			1	ľ		
				13	-10.1	1					
Pu	pu(oh)4??	cement-equilibrated water + E-5M D-saccharic	dilute	12		oversaturation	0.02	200	90	Cross et al., 1989	4,16
Pu	pu(oh)4??	cement-equilibrated water + E-4M D-saccharic	dilute	12		oversaturation	0.02	200		Cross et al., 1989	4,16
Pu	pu(oh)4??	cement-equilibrated water + E-3M D-saccharic	dilute	12		oversaturation	0.02	200		Cross et al., 1989	4,16
Pu	pu(oh)4??	cement-equilibrated water + E-2M D-saccharic	dilute	12		oversaturation	0.02	200		Cross et al., 1969	4,10
Pu	pu(oh)47?	cement-equilibrated water + E-5M D-gluconic	dilute	12		oversaturation	0.02	200		Cross et al., 1989	4,16
Pu	pu(oh)4??	cement-equilibrated water + E-4M D-gluconic	dilute	12		oversaturation	0.02	200		Cross et al., 1989	4,16
Pu	pu(oh)4??	cement-equilibrated water + E-3M D-gluconic	dilute	12		oversaturation	0.02	200		Cross et al., 1989	4,16
Pu	pu(oh)4??	cement-equilibrated water + E-2M D-gluconic	dilute	12		oversaturation	0.02	200		Cross et al., 1989	4,16
Pu	pu(oh)4??	cement-equilibrated water + E-5M glutaric	dilute	12		oversaturation	0.02	200		Cross et al., 1989	4,16
Pu	pu(oh)4??	cement-equilibrated water + E-4M glutaric	dilute	12	* ····	oversaturation	0.02	200		Cross et al., 1989	4,16
Pu	pu(oh)4??	cement-equilibrated water + E-3M glutaric	dilute	12		oversaturation	0.02	200		Cross et al., 1989 Cross et al., 1989	4,16
Pu	pu(oh)4??	cement-equilibrated water + E-2M glutaric	dilute	12		oversaturation	0.02	200		Cross et al., 1989	4,10
Pu	pu(oh)4??	cement-aquilibrated water + E-5M glyceric	dilute	12		oversaturation	0.02	200		Cross et al., 1989	4,16
Pu	pu(oh)4??	cement-equilibrated water + E-4M glyceric	dilute	12		oversaturation	0.02	200			
Pu	pu(oh)4??	cement-equilibrated water + E-3M glyceric	dilute	12		oversaturation	0.02	200		Cross et al., 1989	4,16
Pu	pu(oh)4??	cement-equilibrated water + E-2M glyconc	dilute	12		oversaturation	0.02	200		Cross et al., 1989	4,16
Pu	pu(oh)4??	cement-equilibrated water + E-5M glycolic	dilute	12		oversaturation	0.02	200		Cross et al., 1989	4,16
Pu	pu(oh)4??	cement-equilibrated water + E-4M glycolic	dilute	12		oversaturation	0.02	200		Cross et al., 1989	4,16
Pu	pu(oh)4??	cement-equilibrated water + E-3M glycolic	dilute	12	* ····	oversaturation	0.02	200		Cross et al., 1989	4,16
Pu	pu(oh)4??	cement-equilibrated water + E-2M glycolic	dilute	12		oversaturation	0.02			Cross et al., 1989	4,16
Pu	pu(oh)4??	cement-equilibrated water + E-5M glycolic	dilute	12		oversaturation	0.02	200		Cross et al., 1989	4,16
Pu	pu(oh)4??	cement-equilibrated water + E-5M glyoxylic	ditute	12				200		Cross et al., 1989	4,16
<u></u>		Incrucia administration agree + C. Hist RIAOYANC	Tourna	<u> !2</u>	L39	oversaturation	0.02	200	<u>08 [v</u>	Cross et al., 1989	4,16

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ACTINIDE	SOLID	SOLUTION COMPOSITION	SOLUTION	рH	SOLUBILITY	METHOD	EQtime	Eh (mV)	T (oC)	REFERENCE	NOTES
			DESCRIPTION		(log M)			or atm			
Pu	pu(oh)4??	cement-equilibrated water + E-3M glyoxylic	dilute	12		oversaturation	0.02	200		Cross et al., 1989	4,16
Pu	pu(oh)4??	cement-equilibrated water + E-2M glyoxylic	dilute	12	-6.59	oversaturation	0.02	200	80	Cross et al., 1989	4,16
Pu	238puo2(oh)2	h2O + 0.1M naclo4	dilute	5.6		undersaturation	N/	aratm		Kim et al., 1985b	1,17
				5.8	-4.3						
				5.8	-4,4	7					
			1	5.9	-4.3	1	1	1		1	}
				6	-4.4	1					
			-	6.2	-4.5	1					
				-	6.2	-4,6				1	1
				6.5	-4.5	1	Į	ł	l l	1	ļ
1			Ĩ	6.2	-5						
ļ				6.4	-5.1	4					
	í			6.6	-5	4					
				6.7	-5.3	-					
				8.7	-5.5	4	Į.	l l	ļ	Į.	ļ
1	1			6.8	-5.0	4					
					-5.6	4					
				6.9	-0.0	4					
1				7	-5.5	-{		1		1	
			l .	7	•5.9	4	ļ				1
1				7.1	-5.8	4					
				7.2	-5.7	4	1				1
Ì				7.2	-6	1					
				7.2	-6.3	4			1		
				7.3	-6.1		1		1		<b>i</b> (
1				7.5	<b>∙6</b> .5						
<u>}</u>				7.9	-6.6	]					
				8.4	-6.9	]			i i		1
				8.8	-7.2	1					
			Į	9.1	-7.7	1	1	1			1
1	1			10.1	-8.2	1					
]				10.9	-8.1					1	1
				11.1	-6.2						
				11.2	•7.9	1					
]				11.6	•7.7	1		1		1	
1			ł	11.8	•7.5						
		· ·		11.9	-7.8	1					
ļ				11.9	•7.9	1					
				12.1	-7.9	1			:		
Į			ł	12.2	-7.4	4	1		1	1	1
				12.4	-7.8	4					
	1		]	12.4	-7.8	4			1		
Th	thorianite-tho2	h2o	dilute	2		calculated		t	1		
				5-9	-14		I NA	N N	A 25	Langmuir and Herman, 1980	1
Th	thorianite-tho2	h2o+1ppm{c2o4(oxalate)	dilute	2		calculated		. <del> </del>	<del></del> _=		<b> </b>
l		ine of the information	Curra	4.5			NA	N	n 25	Langmuir and Herman, 1980	1
			1	4.5	- <del>14</del>	4	1	1	1		
Th	thorianite-tho2	h2o+0.tppm(EDTA	-	/-9	-14			<u> </u>		<u> </u>	I
1 '''			dilute	2.5	-6	calculated	N/	N	A 25	Langmuir and Herman, 1980	1
Th	thorianite-tho2	h2n . 0 2nnmli		8.5	-14	<u> </u>		<u> </u>			
10	uronamta-1602	h2o+0.2ppm{/	dilute	2		calculated	N/	N N	A 25	Langmuir and Herman, 1980	1
	the dealer the fl		l	5.7							
Th	thorianite-tho2	h2o+0.1ppm(po4 .	dilute	2	.6	calculated	NA		A 25	Langmuir and Herman, 1980	1
1				4	-9.5		1	1	1	1	1 1
L	J	<u> </u>	<u> </u>	7.5	-14	1	I	1	1		1 1
				- ····	-	······································					

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ACTINIDE	SOLID	SOLUTION COMPOSITION	SOLUTION	рH	SOLUBILITY	METHOD	EQtime	Eh (mV)	T (oC)	T (oC)	REFERENCE	NOTES
			<b>DESCRIPTION</b>		(log M)	1		or alm		+ · · · · ·	· · · · · · · · · · · · · · · · · · ·	
Th	thorianite-tho2	h2o+100ppm(so4	dilute	2	-3.5	calculated	NA	···· ···	NA 2	A 25	Langmuir and Herman, 1980	1
<u> </u>				5-7.5			Ì				· · · · · · · · · · · · · · · · · · ·	
Th	thorianite-tho2	h2o+10ppm(cl+2.5ppm(no3+100ppm(so4+0.3ppm(f+0.1ppm {po4	dilute	2	-4	calculated	NA		NA 2	A 25	Langmuir and Herman, 1980	1
	1			4	-9.5	1	1	1		1 1		
				7.8.5	-14	1	ļ	ļ				
Th	hydrous thorium (IV) oxide	h2o + 0.6M KCl	saline	3.83	-2.19	undersaturation	7	ar atm	amble	ambient	Felmy et al., 1991	2
	1			4.68	-4.17	1	1					
		1		5.42	-6.43							
			l	6.05 6.44	-9 -8.41	4	l	1				1
	]			<u>6.44</u> 7.48	-8.41 -8.68		[	1				1
		· ·		8.03	-8.67							
Th	hydrous thorium (IV) oxide	h2o + 0.6M NaCl	saline	3.02		undersaturation	7	ar atm	embier	embient	Felmy et al., 1991	2
				3.69	-2.16		7		AUDIO	anoient	County of Sir 1991	2 Z
			· ·	4.09	-2.17	1	7	1				· ·
			l	4.14	-2.19	]	7	]				Į.
	]			4.81	-3.87		7	]				
			· ·	5.21	-5.73	4	7					
	1			5.59	-8.53	1	7			1 1		
				6:06	-7.97		7	4				l
				6.58 7.01	-7.08 -7.36	4	7	4				
			ĺ	7.34	-8.38		7	ł	ļ			Į
				7.61	-8.3	1	7	ł				
	(			8.28	-8.07		7	1		1 1		
				9.23	-9.09	1	7	1				ſ
				9.74	-8.82	]	7					
				10.2	-8.95		7					
				2.87	-2.17		98	l		1 1		l
			]	3.42	-2.18	1	98 98					
			-	3.86 3.91	-2.29 -2.28	4	98	1				
				4.38	-2.20	-	98 98 98					
				3.86	-3.14		90					
				3.77	-2.86	1	98					
				4.35	-3.21	1	98		ł			
	}			6.69	-8.15	]	98 98 98	1				
	1			7.18	-8.12		98	I				
			1	7.5	-6.92	1	<u>98</u> 98					
				8.21	-5.92	ł	98					
				9.08	•7.6		98					
		Į	1	9.58 10.04	-7.97 -8.16		98 98					
Th	hydrous thorium (IV) oxide	h2o + 1.2M NaCl	saline	2.94		undersaturation		ar atm	ambler	lambient i	Felmy et al., 1991	<u> </u>
		1		3.58	-2.16			a, aun	annoier		only of al., 1001	2
				4.1	-2.2	1	7					
	J			4.52	-3.09	]	7					
	ļ			4.79	-2.73	]	7		1			
	1	Į – – – – – – – – – – – – – – – – – – –	l I	5.68	-7.69	<u> </u>	7		{	{ }		
	[		<b>i</b> 1	5.83	-6.39	1	7					
		· · · · ·		6.30	-8.9		7					
	I,		L	6.76	-8.3	L	7	1	1	1 1	1	

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### ) ANDIX G

ACTINIDE	SOLID	SOLUTION COMPOSITION	SOLUTION	рН	SOLUBILITY	METHOD	EQtime	Eh (mV)	T (oC)	REFERENCE	NOTES
<u></u>			DESCRIPTION		(log M)		(days)	or atm			I
Th	hydrous thorium (IV) oxide	h2o + 1.2M NaCl	saline	7.16		undersaturation		ar atm	ambient	Felmy et al., 1991	2
				7.63	-8.57	4	7	4			
				8.21	-8.83	ł	7	4			
				8.64	-8.62	4	7			1	
				9.09	-8.8	4	7	4			
				9.52 10.03	-8.25 -7.1	4	7	4			
l				2.67	-2.2	4	98	4	ļ	1	1
				3.3	-2.19	4	98	-			Į
				3.76	-2.48	-	98	-			
1				4.17	•3.16		98	-			
1				4.37	-3.9	1	98	-			
ł				4.08	-2.83	1	98	1			
1				3.99	-2.75		98	1			
				3.97	-4.13		98	1	1		
1		l .		5.91	-7.51	1	98	4	l	Į.	· ۱
				8.92	-7.46		98	1		1	
				7.47	-7.9		98	]		1	
		··		8.05	-7.8		98	]	1		
				8.44	-7.82		98	]			1
				8.86	-7.38		98	]	ł		
				9.3	-7.08		98				
	huden a the store (BD) suites			9.8	-6.14		98		L		
Th	hydrous thorium (IV) oxide	h2o + 3M NaCl	brine	3.36	+2.95	undersaturation		ar atm	ambient	Feimy et al., 1991	2
				4.27	-3.3	-	8				
	4			4.32 4.52	-3.33	-	8		1		
				4.62	·3.71		8	4			
				4.76	-4.09 -4.32	4	8				
1				<u>4.50</u> 5	-4.32	-	8 8				
				5.58	-6.98		8	4	l		
				5.61	-6.39	-	8	4			
4				5.81	-6.84		8		i i		
	ļ			5.99	-6.94		8				
				6.12	-7.28	1	6	1	1		
				6.41	-7.61	1	8	1			
				6.42	-7.62	]	8	1	ĺ		1
				6.44	-7.89	]	8	1			
ł				8.27	-7.64		8	1			
				3.56	-2.17	]	122				
1	1	}	1	3.87	-3.03		122 122	]	]	1	
				3.98	-3.61		122	]			
				3.95	-3.9	1	122	1	ŀ		
	4			4.02	-3.94	4	122	4	I.		
	1		1	4.32	-4.1	4	122	4			
	ł			7.12	·6.47		122	4			
				7.77	<del>· 6.44</del>	4	122	4	1		[
	}			7.82	-8.43		122	4			
{	1		1	7.93	-6.37		122	4	1		
				8.82	-7.84	4	122	4			j
				9	•7.92		122	4			
			]	9.47	•7.2	ł	122	4			
L	L	l	L	9.58	-7.66	L	122	<u> </u>	1		1

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ACTINIDE	SOLID	SOLUTION COMPOSITION	SOLUTION	ρH	SOLUBILITY	METHOD	EQtime	Eh (mV)	T (oC)	REFERENCE	NOTES
			DESCRIPTIO	N I	(log M)			or atm			
Th	hydrous thorium (IV) oxide	h2o + 3M NaCl	brine	10.06		undersaturation		ar aim	amblent	Felmy et al., 1991	2
	l			10.1	-7.45	]	122	1			
	1			3.61	-2.09	4	372				
			1	3.69	-3.56	4	372	<i>'</i>	{		
				3.81	·2.87	-	372	1			
				4.05	·3.28 -3.77		372	4			
				4.56	-5.11		372 372	1	ļ		
				4.65	-4.79		372	1	1		
				7.89	-6.85	1	372	4			
	( *** )			7.98	-6.66	4	372	1	{		
				8.2	-6.96	1	372	1			
				8.11	-7.09	1	372	1			
	1			8.04	.7.73	1	372	1			
				8.05	-7.73		372	1			
				8.24	-6.63	]	372	]			
				8.48	-7.68		372				
υ	233u-doped PNL 76-68 glass	naci brine, WIPP brine B	brine	NA		undersaturation	2	13.8MPa ar	150	Westsik et al., 1983	1,12,13,14
1				NA		-	4				
1				NA			8	ł			
	1			NA			16				
υ	uraninite-uo2	h2o	dilute	<u>NA</u>			32		L		
Ŭ	Granning-DOZ		CILLING	2		calculated	NA		-	Langmuir, 1978	1
				9				<200			
U	uraninite-uo2	h2o+E-2atmPco2	dilute	8		calculated	NA	<-100	<u> </u>	h an annuis 4070	
-				8		-	N/4	<-200	25	Langmuir, 1978	1
U	uraninite-uo2	h2o+E-3.5atmPco2	dilute	8		calculated	NA		25	Langmuir, 1978	
1			4	8	-4			100		Landhingu' 1910	'
U	uraninite-uo2	h2o+E-2atmPco2+E-6M{po4	dilute	6		calculated	NA		25	Langmuir, 1978	1
		"		6	-4			150	1 -		1 1
U	uraninite-uo2	h2o+0.11125Mhcl	dilute	1.04	-6.717	undersaturation	NA	h2=50MPa	100	Parks and Pohl, 1988	3,4
				1.04	•7.022	1					
U	uraninite-uo2	h2o+1.51E-3Mhcl+0.098Mnacl	dilute	2.92	-8.452	undersaturation	NA	h2=50MPa	100	Parks and Pohl, 1988	3,4
				2.92	-8.733						
U	uraninite-uo2	h2o+1.22E-3Mhcl	dilute	2.93		undersaturation	NA	h2=50MPa	100	Parks and Pohi, 1988	3,4
U	uraninite-uo2			2.93	-8.766				<u> </u>	· · · · · · · · · · · · · · · · · · ·	
U	summine-uoz	h2o+9.366E-6Mhcl	dilute	5.03		undersaturation	NA	h2=50MPa	100	Parks and Pohl, 1988	3,4
U	uraninite-uo2	h2o+1.136E-3Mhcl	dliute	5.03	-9.914						
U	uraninite-uo2	h2o	dilute	<u>3.95</u> 6.67		undersaturation undersaturation		h2=50MPa h2=50MPa		Parks and Pohl, 1988	3,4
Ŭ		n Lu	Ginne	6.67	-10.015			02=50WP8	100	Parks and Pohl, 1988	3,4
U	uraninite-uo2	h2o+0.01097Mhcl	dilute	2.01		undersaturation	NA	h2=50MPa	100	Dode and Dabl 1000	
U	uraninite-uo2	h2o+1.26E-3Mhcl	dilute	1.85	-9.377	undersaluration		h2=50MPa		Parks and Pohl, 1986 Parks and Pohl, 1988	3,4 3,4 3,4
U	uraninite-uo2	h2o+0.01569Mnaoh+0.0866Mnacl	dilute	1.04		undersaturation		h2=50MPa		Parks and Pohl, 1988	3,4
U	uraninite-uo2	h2o+0.11125Mhcl	ditute	1.05		undersaturation		h2=50MPa		Parks and Pohl, 1988	3,4
				1.05	-7.147	1					0,4
				1.05	-7.259	1					
U	uraninite-uo2	h2o+1.51E-3Mhcl+0.098Mnacl	dilute	2.93		undersaturation	NA	h2=50MPa	150	Parks and Pohl, 1988	3,4
				2.93	-8.676	]				{	1 -11
U	uraninite-uo2	h2o+1.22E-3Mhcl	dilute	2.94		undersaturation	NA	h2≈50MPa	150	Parks and Pohl, 1988	3,4
				2.94	-8.557	L	L				
U	uraninite-uo2	h2o+9.366E-6Mhcl	dilute	5.02	-9.733	undersaturation	NA	h2=50MPa	150	Parks and Pohl, 1988	3,4

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# NDIX G

ACTINIDE	SOLID	SOLUTION COMPOSITION	SOLUTION	рН	SOLUBILITY	METHOD	EQtime	Eh (mV)	T (oC)	REFERENCE	NOTES
			DESCRIPTION		(log M)			or atm			
1	uraninite-uo2	h2o+9.366E-6Mhcl	dilute	5.02		undersaturation	NA	h2≈50MPa	150	Parks and Pohl, 1988	3,4
J.	uraninite-uo2	h2o+1.136E-3Mhct	dilute	3.95	-9.704	undersaturation	NA	h2=50MPa	150	Parks and Pohl, 1988	3,4
J	uraninite-uo2	h2o	dilute	5.89	the second se	undersaturation	NA	h2=50MPa	150	Parks and Pohl, 1988	- 3,4
				5.89	-9.474				1.00	Tanto and Folin, 1900	3,
U	uraninite-uo2	h2o+0.01097Mhcl	dilute ·	2.01	-9.347 -9.263	undersaturation	NA	h2=50MPa	150	Parks and Pohl, 1988	3,
Ŭ	uraninitø-uo2	h2o+1.28E-3Mhcl	dilute	1.86	-9.335	undersaturation	NA	h2≖50MPa	150	Parks and Pohl, 1988	3,
U	uraninite-uo2	h20+0.11125Mhcl	dilute	1.86	-9.422	undersaturation	NÁ	h2=50MPa	200	Parks and Pohi, 1988	
-			Gildto	1.08	-7.2	]		12-30WF	200	Parks and Pom, 1968	3,4
<u>.</u>	uraninite-uo2	h20+1.51E-3Mhcl+0.098Mnact		1.08	-7.45		<u> </u>				
U	unammale-boz		dilute	2.95	-8.507	undersaturation	NA NA	h2⇒50MPa	200	Parks and Pohl, 1988	3,
U	uraninite-uo2	h2o+1.22E-3Mhcl	difute	2.94	-8.256	undersaturation	NA	h2=50MPa	200	Parks and Pohl, 1988	3,
U	uraninite-uo2	h20+9.366E-6Mhcl	dilute	2.94	-8.652	undersaturation		h2=50MPa	200	Parks and Pohl, 1988	
				5.01	-9.714			nz=ouwra	200	Parks and Poni, 1908	3,4
U	uraninite-uo2	h2o+1.136E-3Mhcl	dilute	3.95	-9.403	undersaturation	NA	h2=50MPa	200	Parks and Pohl, 1988	3,4
<del>v</del>	uraninite-uo2	h2o	dilute	<u>3.95</u> 5.64	-9.551	undersaturation	NA	h2=50MPa	200	Parks and Pohl, 1998	3,
		······································		5.64	-9.598				200	1 Unto and 1 Offi, 1900	
U	uraninitø-uo2	h2o+0.01097Mhcl	dilute	2.02	-9.237	undersaturation	NA	h2=50MPa	200	Parks and Pohl, 1988	3,
U	uraninite-uo2	h2o+1.28E-3Mhcl	dilute	1.87	-9.098	undersaturation	NĀ	h2=50MPa	200	Parks and Pohl, 1988	3,4
U	uraninite-uo2	h20+1.00E-3Mhcl+0.0986Mnact	dilute	<u>1.87</u> 3.43	-9.335	undersaturation			+		
				3.43	-8.468	Junuoisaluranon		h2=50MPa	200	Parks and Pohl, 1988	3,
U	uraninite-uo2	h2o+0.0342Mhcl+0.0682Mnacl	dilute	1.6	-8.013 -8.021	undersaturation	NA	h2=50MPa	200	Parks and Pohl, 1988	3,4
U	uraninite-uo2	h2o+3.07E-3Mhcl+0.0969Mnacl	dilute	2.64		undersaturation	NA	h2=50MPa	200	Parks and Pohl, 1988	
υ υ	uraninite-uo2	h2o+3.17E-4Mhcl+0.0992Mnacl	dilute	3.59	-9.034			h2=50MPa		Parks and Pohl, 1988	3,
Ű	uraninitø-uo2	h2o+0.0601Mhcl+0.0399Mnacl	dilute	2.35	-8.885	undersaturation		h2⊨50MPa		Parks and Pohl, 1988	3,
U	uraninite-uo2	h20+0.0601Mhcl+0.0399Mnacl+1.23E-5uo2(no3)2	dilute	2.35	-9.175	undersaturation	NA	h2=50MPa	200	Parks and Poh), 1988	3,
		·····		1.35	-8.228						1 .
U	uraninite-uo2	h2o+0.01569Mnaoh+0.0866Mnacl	dilute	9.3	-9.024	undersaturation	NA	h2=50MPa	200	Parks and Pohl, 1988	3,4
U	uraninite-uo2	h2o+0.11125Mhcl	dilute	1.14	-9.189 -7.132	undersaturation		h2=50MPa	250	Parks and Pohl, 1988	3,4
				1.14	-6.466			UP-20141L S	200	Fains and Polit, 1900	3,4
	 			1.14	-7.117	·			]	1	
U	uraninite-uo2	h2o+1.51E-3Mhcl+0.098Mnacl	dilute	3.02	-8.437 -8.413	undersaturation	NA	h2=50MPa	250	Parks and Pohl, 1988	3,4
U	uraninite-uo2	h2o+1.22E-3Mhcl	dilute	2.94	-8.305	undersaturation	NA	h2≈50MPa	250	Parks and Pohl, 1988	3,4
U	uraninite-uo2	h20+9.366E-6Mhcl	dilute	2.94	-8.621			10 FR1	<del> </del>		
×			CHURNE	5	-9.82	undersaturation		h2=50MPa	250	Parks and Pohl, 1988	3,
<u>U</u>	uraninite-uo2	h2o+1.136E-3Mhcl	dilute	3.95		undersaturation	NA	h2=50MPa	250	Parks and Pohl, 1988	3.4
<u> </u>	uraninite-uo2	h2o	dilute	5.55	-9.519			h2=50MPa		Parks and Pohl, 1988	3.4
υ	uraninite-uo2.	h2o+0.01097Mhcl	dilute	2.04		undersaturation	NA	h2=50MPa		Parks and Pohl, 1988	3,4 3,4 3,4
	<u> </u>	<u>_</u>	<u>L</u>	2.04	-9.531	<u> </u>				1	

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ACTINIDE	SOLID	SOLUTION COMPOSITION	SOLUTION	pН	SOLUBILITY	METHOD	EQtime	Eh (mV)	T (oC)	REFERENCE	NOTES
			DESCRIPTION		(log M)		(days)	or atm			
U	uraninite-uo2	h2o+1,26E-3Mhci	dilute	1.89		undersaturation	NA	h2≂50MPa	250	Parks and Pohl, 1988	3,4
U	uraninite-uo2	h2o+0,11125Mhcl		1.89	-8.889				1	<u>, , , , , , , , , , , , , , , , , , , </u>	
0	Granmate-GOZ	120+0,11125Minci	diłute	1.23	-6.096		NA	h2=50MPa	300	Parks and Pohl, 1988	3,4
				1.23	-6.128			1'	1		
				1.23	-6.056	4					
U				1.23	-6.121						
0	uraninite-uo2	h2o+1.51E-3Mhcl+0.098Mnacl	dilute	3.12		undersaturation	NA NA	h2≈50MPa	300	Parks and Pohl, 1988	3,4
U	uraninite-uo2	h2o+1.22E-3Mhci	dilute	3.12 2.95	-8.089	undersaturation	NA NA	h2=50MPa	200	Parks and Pohl, 1988	
Ū	uraninite-uo2	h2o+9.366E-6Mhcl	dilute	4.99	-9.502			h2=50MPa		Parks and Pohl, 1988	3,4
			0.000	4.99	-9.502		[ "	INC-JUNIFA	1 200	Fains and Folia, 1900	3,4
U	uraninita-uo2	h20+1.136E-3Mhcl	dilute	3.96		undersaturation	NA	h2=50MPa	200	Parks and Pohl, 1988	3,4
				3.96	-9.82				1 300	Faiks aiki Fosi, 1900	3,4
υ	uranInite-uo2	h2o	dilute	5.57	the second s	undersaturation	NA	h2=50MPa	300	Parks and Pohl, 1988	3,4
-			Gildro	5.57	-9.403			112-301417-B	1 300	Faiks and Polit, 1900	3,4
U	uraninite-uo2	h2o+0.01097Mhcl	dilute	2.07		undersaturation	MA	h2=50MPa	1 200	Parks and Pohl, 1988	3,4
			Chart	2.07	-9.297				1	Faiks and Fond, 1900	3,4
U	uraninita-uo2	h2o+1.26E-3Mhcl	dilute	1.93		undersaturation	NIA	h2=50MPa	- 200	Parks and Pohl, 1988	3,4
-			cillote	1.93	-8.652	differentiation		UIZ-JUNIPA	1 300	Faiks and Ford, 1986	3,4
U	uraninite-uo2	h2o+1.00E-3Mhci+0.0988Mnacl	dilute	3.59		undersaturation	MA	h2=50MPa	- 200	Parks and Pohl, 1988	
-				3.59	-8.479		147	HZ=SONFA	300	Parks and Pont, 1900	3,4
U	vraninite-uo2	h2o+0.0342Mhcl+0.0662Mnacl	dilute	1.75		undersaturation	NIA	h2=50MPa	1 200	Parks and Pohl, 1988	
-			Cilloro	1.75	-7.68	unconsecondition	1 11	Solar a	300	Faiks and Fom, 1966	3,4
U	uraninite-uo2	h2o+3.07E-3Mhcl+0.0969Mnacl	dilute	2.8	-8.287	undersaturation	Ná	h2=50MPa	1 200	Parks and Pohl, 1988	3,4
				2.8	-8.532				1 300	Faiks and Fom, 1900	3,4
U	uraninita-uo2	h2o+3.17E-4Mhcl+0.0992Mnacl	dilute	3.76		undersaturation	NA NA	h2=50MPa	300	Parks and Pohl, 1988	3,4
				3.76	-8.977		1 1 1	112-30MIT 8			3,4
U	uraninite-uo2	h2o+0.0601Mhcl+0.0399Mnacl	dilute	2.51		undersaturation	NA	h2=50MPa	300	Parks and Pohl, 1988	3,4
				2.51	-8.531		· '''		1		5,4
U	uraninite-uo2	h2o+0.0601Mhcl+0.0399Mnacl+1.23E-5uo2(no3)2	dilute	1.5		undersaturation	NA	h2=50MPa	300	Parks and Pohl, 1988	3,4
ł				1.5	-7.464		"		}		5,4
U	uraninite-uo2	h2o+0.01569Mnaoh+0.0866Mnacl	dilute	9.07		undersaturation	NA	h2=50MPa	300	Parks and Pohl, 1988	3,4
U	uraninite-uo2	saturated NaCl solution	brine	6.2		undersaturation		air		Gray, 1986	1,2,9
				6.2	-7						1,2,3
				8.3	-7.5				1		
			1	6.4	-7.9				1		
				6.4	-7.8			1			
				6.4	-7.6	1	]	1	1		
U	camolite-k2(uo2)2(vo4)2	h2o+E-2atmPco2+E-3Mk+E-6M(v	dilute	3	-2.5	calculated	NA	N/	25	Langmuir, 1978	1
				6	•7.5			>100		Langinan, ivia	
				8.5	-1	1		>50	-		
U	camotite-k2(uo2)2(vo4)2	h2o+E-3.5atmPco2+E-3Mk+E-6M(v	dilute	3	-2.5	calculated	NA		_	Langmuir, 1978	1
				7	-9			>100			,
				9	-4	1	}	>50	-	1	1
U	tyuyamunite-ca(uo2)2(vo4)2	h2o+E-2aImPco2+E-2.7Mca+E-6M(v	dilute	3	-2	calculated	NA			Langmuir, 1978	
				6	-7	]			l l		
				8.5	· -1						
U	tyuyamunite-ca(uo2)2(vo4)2	h2o+E-3.5atmPco2+E-2.7Mca+E-6M(v	ditute	3	-2	calculated	NA	NA	25	Langmuir, 1978	1
				7	-8	1	ł				
				9	-3.5		l	I	1	Į	
υ	autunite ca(uo2)2(po4)2	h2o+E-2atmPco2+E-2.7Mca+E+8M{po4	dilute	7	-4	calculated	NA	N/	25	Langmuir, 1978	
				9.5	Ö						
U	autunite-ca(uo2)2(po4)2	h2o+E-3.5atmPco2+E-2.7Mca+E-6M(po4	dilute	7	-6	calculated	NA	NA	26	Langmuir, 1978	1

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### ATTACHMENT #1

ACTINIDE	SOLID	SOLUTION COMPOSITION	SOLUTION	pН	SOLUBILITY	METHOD	EQtime	Eh (mV)	T (oC)	REFERENCE	NOTES
			DESCRIPTION		(log M)			or alm			
U	autunite-ca(uo2)2(po4)2	h2o+E-3.5atmPco2+E-2.7Mca+E-8M(po4	dilute	10		calculated	NA	N N	A 25	Langmuir, 1978	1
	k-autunite-k2(uo2)2(po4)2	h2o+E-2aimPco2+E-3Mk+E-6M(po4	dilute	6 9.5	- <del>6</del> 0	calculated	NA	N N	A 25	Langmuir, 1978	1
U	k-autunite-k2(uo2)2(po4)2	h2o+E-3.5almPco2+E-3Mk+E-8M(po4	dilute	<u>6</u> 10		calculated '	NA	N N	A 25	Langmuir, 1978	1
U	schoepite-uo3.2h2o(syn)	h2o + hclo4 or tetramethyl nh4oh to adjuet pH	difute	3.5 4 6 8 11 12 3 4 5 6 7 7 8 10 11		oversaturation	9 9 9 9 9 9 14-53 14-53 14-53 14-53 14-53 14-53 14-53 14-53		25	Krupka at al., 1985	1,2
U	schoepite-uo3.2h2o(syn)	h2o + hclo4 or tetramethyl nh4oh to adjust pH	dilute	12 4 8 9 11 12 3 4 5 7.5 8.5 9.5 11 12	-2.5	undersaturation	14-53	0X	25	Krupka et al., 1985	1,2
U	schoepite-uo3.2h2o(s)	h2o + 0.5M nacio4	dilute	6.9 7 7.2 7.3 7.4 7.5 7.6 7.7 7.8 7.8 7.9 7.9 7.9 8.05 8.15		undersaturation		n2 atm	25	Bruno and Sandino, 1989	1,17
U	schoepite-uo3.2h2o(c)	h2o + 0.5M naclo4	dilute	8.15 6.8 6.95 7.16 7.25 7.4		undersaturation	NA	n2 atm	25	Bruno and Sandino, 1989	1,17

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ACTINIDE	SOLID	SOLUTION COMPOSITION	SOLUTION	рH	SOLUBILITY	METHOD	EQtime	Eh (mV)	T (oC)	REFERENCE	NOTES
			DESCRIPTION		(log M)		(days)		1.700/		
U	schoepite-uo3.2h2o(c)	h2o + 0.5M naclo4	dilute	7.5		undersaturation		n2 atm	25	Bruno and Sandino, 1989	1,17
				7.65	-4.9			1			''''
				7.7	-4.95						
	í			7.85	-5.15			•		•	
	[			7.9	-5.1	1		[		1	
				8.1	-5.25	1		1			
	1			8.25	-5.3			1			
				8.3	-5.35			1	1		1
				8.35	-5.4						
	1			8.33	-5.05						
				8.85	-4.55		· ·		1		
U	na2u2o7	h2o sat w/ ca(oh)2, fe(oh)2, and nacl	brine	NA		undersaturation	NA	N N	A NA	Marx and Keiling, 1989	4.18
U	na2u2o7	h2o sat w/ ca(oh)2, fe(oh)2, nacl and TBP	brine	NA	-4.98	undersaturation	NA	Ň		Marx and Keiling, 1989	4,18
U.	na2u2o7	h2o sat w/ ca(oh)2, fe(oh)2, nacl and DBP	brine	NĂ		undersaturation	NĂ	N	A NA	Marx and Keiling, 1989	4.18
U	na2u2o7	h2o sat w/ ca(oh)2, fs(oh)2, nacl and EDTA	enind	NÄ		undersaturation	NA	N		Marx and Kelling, 1989	4,18
U	na2u2o7	h2o sat w/ ca(oh)2, fe(oh)2, nacl and clirate	brine	NA		undersaturation	NA			Marx and Keiling, 1989	4,18 4,18 4,18 4,18 4,18
U	na2u2o7	h2o sal w/ ca(oh)2, fe(oh)2, nacl and oxalate	brine	NA		undersaturation	NA	N.		Marx and Keiling, 1989	4,18
Ū	freshly declad spent fuel	PBB1	brine	NA		undersaturation	5	air atm		Gray, 1986	1,2,9
				NA			5	]			
				NĂ			14	]			1
				NA			14 28				i i
	· · · · · · · · · · · · · · · · · · ·			NA			28	]			
	1			NA			28			1	
	ļ		1	NĀ			60	]			1
				NA			60			·	
U	previously declad spent fuel	PBB1	brine	NĂ		undersaturation	5	air atm	25-30	) Gray, 1986	1,2,9
				NA			5	]	1		
				NA			14 28 28				
				NA			28			1	
				NA		1	28			1	
				NA	-3.9		60	1			
		•		NĂ			<u>60</u> 90	1			
	1			NA			90	Į			
				NA	-4.2		120	1			
				NA	-4		180	[	1		ſ
				NA	-4.8		180				
U	uo2	PBB1	brine	NA		undersaturation		air atm	25-30	Gray, 1986	1,2,9
			· · ·	. <u>NA</u>	-6.3			1			
				NA	-6.2		28				1
	I		I	NA	-6		60				

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# ENDIX G

#### REFERENCES

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#### NOTES

1 = data obtained from graphical results

2 = concentration in 18A litrate

3 = concentration in 2000A filtrate

4 = data obtained from tabulated results

5 = concentration in 150A filtrate

6 = some solutions contained 10mg caco3

7 = concentration in 10A filtrate

8 = in pH solutions <7, essentially all am(oh)3 dissolved

i.e., maximum am+3 = E-3

9 = pH of sample not reported, initial pH = 6.2 to 6.4

10 = concentration in 20A filtrate

11 = PBB3 is similar to BSEP brines

12 = nonflitered solutions acidified with HNO3

13 = log M calculated from normalized release value

14 = glass wt loss increased linearly with time

15 = concentration in 1000A filtrate

16 = actinide conc in solution determined by difference between added conc and activity of 18A filtered pot

17 = filter size unknown

18 = no details on the experimental conditions

19 = concentration in 13A filtrate

20 = concentration in 2200A filtrate

21 = ultrafiltration noted; size unknown

NA = not available

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