CONTAINER LIFE

AND

SOURCE TERM KTI

MATERIALS

308 - - - Q200405260006

Analysis of Calcium, Sodium, Silicon, and Uranium by ICP Methodology and Metals by ICP and Total Uranium Analyses: Work Order: 9081, 8939, and 7939; Samples Received: May 08, 1996, May 28, 1996, August 29, 1995, and November 01, 1995

MEMORANDUM

TO: James Prikryl
Division 20

FROM: Jo Ann Boyd
Division 01

RE: Project No.: 20-5708-573
Work order #: 9081
Analysis for Calcium, Sodium, Silicon, and Uranium by ICP Methodology

DATE: May 28, 1996

Enclosed please find the sample results for the analysis referenced above.

If there are any questions, please feel free to contact me by voice mail 522-2169, fax at 522-2021, or e-mail at JBoyd@Smpl_mgr@SwRI01. I look forward to our continued analytical support of your projects.

CLIENT: DIVISION 20
SDG: 71369 (20AD)

METALS ANALYSIS

SOUTHWEST RESEARCH INSTITUTE

SAMPLE ANALYSIS DATA SHEET

Lab Name: Southwest Research Institute

Client: Division 20

Lab Code: SWRI

Date Received: 05/20/96

Matrix: Liquid

Project No.: 20-5708-573

Sample ID	Lab System ID	Calcium Result (ug/mL)	Silicon Result (ug/mL)	Sodium Result (ug/mL)	Uranium Result (ug/mL)
20AD	71369	4.80	6.91	<0.1	54.3
Duplicate	71369	4.82	6.74	<0.1	52.3
RPD	71369	0.4%	2.5%	0.0%	3.8%
Spike	71369	15.6	16.8	8.30	100
Spike Added	71369	10	10	10	50
Recovery	71369	108.0%	98.9%	83.0%	91.4%
20AE	71370	10.3	15.4	21.8	48.1
20AF	71371	9.33	13.5	<0.1	104
20AG	71372	5.16	10.4	17.2	133
20AH	71373	4.77	6.74	<0.1	52.6
20AI	71374	8.24	7.24	10.9	85.1
20AJ	71375	9.44	13.3	<0.1	103
20AK	71376	4.76	6.74	<0.1	51.8
20AL	71377	4.71	6.66	<0.1	51.7
Detection Limit:		0.1 ug/mL	0.1 ug/mL	0.1 ug/mL	0.1 ug/mL

SOUTHWEST RESEARCH INSTITUTE

SAMPLE ANALYSIS DATA SHEET

Lab Name: Southwest Research Institute

Client: Division 20

Lab Code: SWRI

Date Received: 05/20/96

Matrix: Liquid

Project No.: 20-5708-573

Sample ID	Lab System ID	Calcium Result (ug/mL)	Silicon Result (ug/mL)	Sodium Result (ug/mL)	Uranium Result (ug/mL)
20AD	71369	4.80	6.91	<0.1	54.3
Duplicate	71369	4.82	6.74	<0.1	52.3
RPD	71369	0.4%	2.5%	0.0%	3.8%
Spike	71369	15.6	16.8	8.30	100
Spike Added	71369	10	10	10	50
Recovery	71369	108.0%	98.9%	83.0%	91.4%
20AE	71370	10.3	15.4	21.8	48.1
20AF	71371	9.33	13.5	<0.1	104
20AG	71372	5.16	10.4	17.2	133
20AH	71373	4.77	6.74	<0.1	52.6
20AI	71374	8.24	7.24	10.9	85.1
20AJ	71375	9.44	13.3	<0.1	103
20AK	71376	4.76	6.74	<0.1	51.8
20AL	71377	4.71	6.66	<0.1	51.7
Detection Limit:		0.1 ug/mL	0.1 ug/mL	0.1 ug/mL	0.1 ug/mL

Distribution List

Serial Number 9081

SwRI
Division 1

YD, JOANN
CUMMINS, WAYNE
DAMMANN, MIKE
LOGIN AREA
METALS PREP LAB
PRIKRYL, JAMES D.
SPIES, RADONNA

Number of Copies: 7

Date Printed: 05/20/96

Number of Work Orders: 7

Southwest Research Institute

Laboratory Work Order

Work Order Number 9081

VTSR: 20 May 96 Time: 15:06

Project: 20-5708-573
Case #: DIV 20
SDG : 71369
Client: DIV 20

Manager: PRIKRYL, JAMES D.
Logged in by: JMORIN
Creation Date: 20 May 96
Checked by: 5-20-96

Notes

SAMPLES RECEIVED AT ROOM TEMP.

QC NOTE: AS PER QAPP.

PARAMETERS: U, CA, SI, AND NA BY ICP.

NOTE: SEE ATTACHED FOR ADDITIONAL INFORMATION. (DETECTION LIMITS, SEND RESULTS TO.)

NOTE: SAMPLES SCREENED FOR RADIOACTIVITY, SAMPLES ABOVE BACKGROUND. SENT TO RADCHEM FOR FURTHER SCREENING. JMJ 05-20-96

System ID	#	QC	Customer ID	CED	Matrix	Required Analyses
71369	1		20AD	/ /	LIQUID	CA, NA, RADSCREEN, SI, U-ICP
71370	1		20AE	/ /	LIQUID	CA, NA, RADSCREEN, SI, U-ICP
71371	1		20AF	/ /	LIQUID	CA, NA, RADSCREEN, SI, U-ICP
71372	1		20AG	/ /	LIQUID	CA, NA, RADSCREEN, SI, U-ICP
71373	1		20AH	/ /	LIQUID	CA, NA, RADSCREEN, SI, U-ICP
71374	1		20AI	/ /	LIQUID	CA, NA, RADSCREEN, SI, U-ICP
71375	1		20AJ	/ /	LIQUID	CA, NA, RADSCREEN, SI, U-ICP
71376	1		20AK	/ /	LIQUID	CA, NA, RADSCREEN, SI, U-ICP
71377	1		20AL	/ /	LIQUID	CA, NA, RADSCREEN, SI, U-ICP
					Samples:	9

Data must be to QA..... 31 May 96
Absolute Latest Date..... 02 June 96

Samples Received to Date: 009
Turnaround time is 14 Days from VTSR.

Date Printed: 20 May 96 Time Printed: 16:19:54

Work Orders in this SDG:

9081

* - Indicates work group contains an MS/MSD

Thermometer: 56
Temperature: 22.0

ver (06/16/95)

Southwest Research Institute

Test Code Key

Serial Number 9081

VTSR: 20 May 96 Time: 15:06

Manager: PRIKRYL, JAMES D.

Project: 20-5708-573
Case #: DIV 20
DG : 71369
Client: DIV 20

NOTES

SAMPLES RECEIVED AT ROOM TEMP.

QC NOTE: AS PER QAPP.

PARAMETERS: U, CA, SI, AND NA BY ICP.

NOTE: SEE ATTACHED FOR ADDITIONAL INFORMATION. (DETECTION LIMITS, SEND RESULTS TO.)

NOTE: SAMPLES SCREENED FOR RADIOACTIVITY, SAMPLES ABOVE BACKGROUND. SENT TO RADCHEM FOR FURTHER SCREENING. JMJ 05-20-96

Group	Test	Start	Method Date	Deadline	Number	Description	Fridge	Shelf
METALS	CA	vtsr	*11/16/96*	05/31/96	9	CA BY ICP	REF11	MID
METALS	NA	vtsr	*11/16/96*	05/31/96	9	ANALYSIS FOR SODIUM BY ICP	REF11	MID
METALS	SI	vtsr	*11/16/96*	05/31/96	9	SILICON BY ICP	REF11	MID
METALS	U-ICP	vtsr	*11/16/96*	05/31/96	9	URANIUM BY ICP.	REF11	MID
RADCHEM	RADSCREEN	vtsr	05/22/96	05/22/96	9	RAD SCREENING PRIOR TO EXTRACTION/PREP/AND-OR/ANALYSIS.	REF11	MID

Data Must be to QA Unit..... 31 May 96

Absolute Latest Date..... 02 June 96

Date Printed: 05/20/96

Time Printed: 16:20:03

Sample List/Chain of Custody

Southwest Research Institute
Chemistry and Chemical Engineering Division
San Antonio, Texas

Page 1 of 1

Installation I.D.: DIV. 20
Project No.: 20-5703-573
Site I.D.:
Zone I.D.:
Sampling Co.:
Airbill No.:
Shipping Container No.:

Parameters ( ) / Preservation [ ]

Sample I.D.	Sample Collection Date (mm/dd/yy)	Sample Collection Time (24 Hr)	Matrix Type	Sample Type	Pt	U, Ca, Si, Na-Zl											Remarks
20 A D			Liquid		1	X											Notify + send
20 A E					1	X											results to
20 A F					1	X											Jim Prikryl
20 A G					1	X											x5667 Bldg 57
20 A H					1	X											Approximate conc.
20 A I					1	X											U - 20-150 ppm
20 A J					1	X											Ca-Si 1-20 ppm
20 A K					1	X											Na - 0-5ppm
20 A L					1	X											Two week
																	turnaround
																	requested

Indicate number of sample containers per analytical method

Preservation: **a** = HCl to pH <2; **b** = HNO_3 to pH < 2; **c** = H_2SO_4 to pH < 2; **d**= NaOH to pH > 12; **e** = Other (Specify)

Relinquished by Sampler: (Signature)	Date	Time	Received by: (Signature)	Laboratory:	
Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Samples Disposed by:	
Relinquished by: (Signature) James D. Pyl	Date 5/20	Time 1506	Received by Lab: (Signature) Joe Marinh	Date 5/20/96	Time 1506

Matrix Types: **A** - Air; **P** - Product; **S**- Soil; **T** - Tissue; **W** - Water

Sample Types: **DM** - Dissolved Metals; **ER** - Equipment Rinsate; **FB** - Field Blank; **MD** - Matrix Spike Duplicate; **MS** - Matrix Spike; **TB** - Trip Blank; **TM** - Total Metals; **ES** - Environmental Samples

Southwest Research Institute
Traffic Report
Sample Custodian Signature: Joe Moring 5-20-96

Date: 05/20/96
Project: 20-5708-573
CASE #: DIV 20 / SDG: 71369
Airbill: DELIVERED
Work Order #: 0000009081

1. Custody Seal — Not Present or Damaged
2. Chain of Custody — Present
3. Sample Tags — Not Present
   Sample Tag Numbers — Not on COC
4. SMO Forms — Not Present

Date RecD	Time RecD	COC Record #	SMO Sample #	Corresponding		TFIC RPT, TAGS, COC AGREE Y/N	Cond of Sample
				Sample Tag #	SwRI Lab #		
05/20/96	15:06	NONE	20AD	NONE	71369		INTACT
05/20/96	15:06	NONE	20AE	NONE	71370		INTACT
05/20/96	15:06	NONE	20AF	NONE	71371		INTACT
05/20/96	15:06	NONE	20AG	NONE	71372		INTACT
05/20/96	15:06	NONE	20AH	NONE	71373		INTACT
05/20/96	15:06	NONE	20AI	NONE	71374		INTACT
05/20/96	15:06	NONE	20AJ	NONE	71375		INTACT
05/20/96	15:06	NONE	20AK	NONE	71376		INTACT
05/20/96	15:06	NONE	20AL	NONE	71377		INTACT

Sample List/Chain of Custody

Southwest Research Institute
Chemistry and Chemical Engineering Division
San Antonio, Texas

Page 1 of 1

Installation I.D.	Project No.
DIV. 20	20-5708-573

Site I.D.	Zone I.D.	Sampling Co.

Airbill No.	Shipping Container No.

Parameters ( ) / Preservation [ ]

Sample I.D.	Sample Collection Date (mm/dd/yy)	Sample Collection Time (24 Hr)	Matrix Type	Sample Type	PT	U, Ca, Si, Na-ICP											Remarks
20 A D			Liquid		1												Notify & send
20 A E					1												results to
20 A F					1												Jim Prikryl
20 A G					1												x5667 Bldg 57
20 A H					1												Approximate conc.
20 A I					1												U - 20-150 ppm
20 A J					1												Ca-Si 1-20 ppm
20 A K					1												Na - 0-5 ppm
20 A L					1												Two week
																	turnaround
																	requested

Indicate number of sample containers per analytical method

Preservation: **a** = HCl to pH <2; **b** = HNO_3 to pH < 2; **c** = H_2SO_4 to pH < 2; **d**= NaOH to pH > 12; **e** = Other (Specify)

Relinquished by Sampler: (Signature)	Date	Time	Received by: (Signature)	Laboratory:	
Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Samples Disposed by:	
Relinquished by: (Signature) James D. Pike	Date 5/20	Time 1506	Received by Lab: (Signature) Joe Marinh	Date	Time

Matrix Types: **A** - Air; **P** - Product; **S**- Soil; **T** - Tissue; **W** - Water

Sample Types: **DM** - Dissolved Metals; **ER** - Equipment Rinsate; **FB** - Field Blank; **MD** - Matrix Spike Duplicate; **MS** - Matrix Spike; **TB** - Trip Blank; **TM** - Total Metals; **ES** - Environmental Samples

Sample List/Chain of Custody

Southwest Research Institute
Chemistry and Chemical Engineering Division
San Antonio, Texas

Page 1 of 2

Installation I.D.	Project No.
Div 20	20-5708-573

Site I.D.	Zone I.D.	Sampling Co.

Airbill No.	Shipping Container No.

Parameters ( ) / Preservation [ ]

Sample I.D.	Sample Collection Date (mm/dd/yy)	Sample Collection Time (24 Hr)	Matrix Type	Sample Type	# of Containers	[redacted]	[redacted]	U, Ca, Si, Na DIT ICP									Remarks
20A1			0.1M HCl	Aqueous	1			✓									Notify and
20A2					1			✓									send results
20A3					1			✓									to Jim Prikryl
20A4					1			✓									x5667 at
20A5					1			✓									Div 20, Bldg 57
20A6					1			✓									Approximate conc.
20A7					1			✓									ranges –
20A8					1			✓									U - 20 To 150 ppm
20A9					1			✓									Ca, Si - 1 To 20 ppm
20AA					1			✓									Na - 0 to 5 ppm

Indicate number of sample containers per analytical method

Preservation: **a** = HCl to pH <2; **b** = HNO_3 to pH < 2; **c** = H_2SO_4 to pH < 2; **d**= NaOH to pH > 12; **e** = Other (Specify)

Relinquished by Sampler: (Signature)	Date	Time	Received by: (Signature)	Laboratory:
[signature]	4/25/96	1510		
Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Samples Disposed by:
Relinquished by: (Signature)	Date	Time	Received by Lab: (Signature)	Date / Time
			R. P.	4/25/96 15:10

Matrix Types: **A** - Air; **P** - Product; **S**- Soil; **T** - Tissue; **W** - Water

Sample Types: **DM** - Dissolved Metals; **ER** - Equipment Rinsate; **FB** - Field Blank; **MD** - Matrix Spike Duplicate; **MS** - Matrix Spike; **TB** - Trip Blank; **TM** - Total Metals; **ES** - Environmental Samples

Sample List/Chain of Custody

Southwest Research Institute
Chemistry and Chemical Engineering Division
San Antonio, Texas

Installation I.D.	Project No.
DIV 20	20-5708-573

Site I.D.	Zone I.D.	Sampling Co.

Airbill No.	Shipping Container No.

Sample I.D.	Sample Collection Date (mm/dd/yy)	Sample Collection Time (24 Hr)	Matrix Type	Sample Type	# of Containers	Parameters ( ) / Preservation [ ] Hg, Cu, Si, Na by ICP	Remarks
20AB			0.1M HCl	Aqueous	1	✓	
20AC			1	1	1	✓	

Indicate number of sample containers per analytical method

Preservation: **a** = HCl to pH <2; **b** = HNO_3 to pH < 2; **c** = H_2SO_4 to pH < 2; **d**= NaOH to pH > 12; **e** = Other (Specify)

Relinquished by Sampler: (Signature)	Date	Time	Received by: (Signature)	Laboratory:	
James D. [illegible]	4/25/96	1510			
Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Samples Disposed by:	
Relinquished by: (Signature)	Date	Time	Received by Lab: (Signature)	Date	Time
			R. [illegible]	4/25/96	15:06

Matrix Types: **A** - Air; **P** - Product; **S**- Soil; **T** - Tissue; **W** - Water

Sample Types: **DM** - Dissolved Metals; **ER** - Equipment Rinsate; **FB** - Field Blank; **MD** - Matrix Spike Duplicate; **MS** - Matrix Spike; **TB** - Trip Blank; **TM** - Total Metals; **ES** - Environmental Samples

MEMORANDUM

TO: James Prikryl
Division 20

FROM: Jo Ann Boyd
Division 01

RE: Project No.: 20-5708-573
Work order #: 8939
Analysis for Calcium, Sodium, Silicon, and Uranium by ICP Methodology

DATE: May 08, 1996

Enclosed please find the sample results for the analysis referenced above.

If there are any questions, please feel free to contact me by voice mail 522-2169, fax at 522-2021, or e-mail at JBoyd@Smpl_mgr@SwRI01. I look forward to our continued analytical support of your projects.

SOUTHWEST RESEARCH INSTITUTE

SAMPLE ANALYSIS DATA SHEET

Lab Name: Southwest Research Institute

Client: Division 20

Lab Code: SWRI

Date Received: 04/25/96

Matrix: Liquid

Date Analyzed: 05/08/96

Project No.: 20-5708-573

Sample ID	Lab System ID	Calcium Result (ug/mL)	Sodium Result (ug/mL)	Silicon Result (ug/mL)	Uranium Result (ug/mL)
20 A1	70230	4.76	<0.1	7.18	56.1
Duplicate	70230	4.55	<0.1	7.13	55.4
RPD	70230	4.5%	0.0%	0.7%	1.3%
Spike	70230	14.1	10.3	17.7	109
Spike Added	70230	10.0	10.0	10.0	50.0
Recovery	70230	93.4%	103.0%	105.2%	105.8%
20 A2	70231	10	23.3	15.6	50
20 A3	70232	11.3	<0.1	17.5	135
20 A4	70233	<0.1	<0.1	4.07	74
20 A5	70234	4.72	<0.1	7.02	55.5
20 A6	70235	8.03	12.1	7.2	87.7
20 A7	70236	11.5	<0.1	17.2	135
20 A8	70237	4.8	<0.1	7.21	57.1
20 A9	70238	<0.1	<0.1	4.06	72.8
20 AA	70239	4.94	18.6	10.3	137
20 AB	70240	4.57	<0.1	6.91	54.1
20 AC	70241	4.65	<0.1	7.2	55.4
Detection Limit:		0.1 ug/mL	0.1 ug/mL	0.1 ug/mL	0.1 ug/mL

Chemical analysis of synthesized uranophanes and soddyites.

Samples were dissolved in the CNWRA lab and solutions were sent to Div 01 for analysis by ICP.
All samples and standards were in a 0.1 M HCl matrix.
Amount of water was measured in CNWRA lab by gravimetry.
Standards were made from certified standard solutions.

Sample ID	Weight (g)	Ca (ppm)	Si (ppm)	U (ppm)	%H2O
URAN*SYN*9	0.101	47.6	71.8	561	12.78
URAN*SYN*9	0.101	45.7	69.1	541	
URAN*SYN*9	0.5056	230	344	2700	
URAN*SYN*10	0.1017	47.2	70.2	555	13.14
URAN*SYN*10	0.5027	226	350	2700	
URAN*SYN*3	0.1034	48	72.1	571	
URAN*SYN*3	0.1034	46.5	72	554	
SODD*SYN*11	0.1065	<0.1	40.7	740	
SODD*SYN*8	0.1016	<0.1	40.6	728	7.72
Standards showing the measured//expected values.					
20A2		10//10	15.6//15	50//50	
20A6		8.03//8	7.2//7	87.7//90	
20AA		4.94//5	10.3//10	137//140	

SOUTHWEST RESEARCH INSTITUTE

SAMPLE ANALYSIS DATA SHEET

Lab Name: Southwest Research Institute

Lab Code: SWRI

Matrix: Liquid

Project No.: 20-5708-573

Client: Division 20

Date Received: 04/25/96

Date Analyzed: 05/08/96

Sample ID	Lab System ID	Calcium Result (ug/mL)	Sodium Result (ug/mL)	Silicon Result (ug/mL)	Uranium Result (ug/mL)
20 A1	70230	4.76	<0.1	7.18	56.1
Duplicate	70230	4.55	<0.1	7.13	55.4
RPD	70230	4.5%	0.0%	0.7%	1.3%
Spike	70230	14.1	10.3	17.7	109
Spike Added	70230	10.0	10.0	10.0	50.0
Recovery	70230	93.4%	103.0%	105.2%	105.8%
20 A2	70231	10	23.3	15.6	50
20 A3	70232	11.3	<0.1	17.5	135
20 A4	70233	<0.1	<0.1	4.07	74
20 A5	70234	4.72	<0.1	7.02	55.5
20 A6	70235	8.03	12.1	7.2	87.7
20 A7	70236	11.5	<0.1	17.2	135
20 A8	70237	4.8	<0.1	7.21	57.1
20 A9	70238	<0.1	<0.1	4.06	72.8
20 AA	70239	4.94	18.6	10.3	137
20 AB	70240	4.57	<0.1	6.91	54.1
20 AC	70241	4.65	<0.1	7.2	55.4
Detection Limit:		0.1 ug/mL	0.1 ug/mL	0.1 ug/mL	0.1 ug/mL

Chemical analyses of synthesized uranophanes in CNWRA lab

Samples URAN*SYN*3, URAN*SYN*9 and URAN*SYN*10 were analyzed for U, Ca, Si, Na and water content.

URAN*SYN*3 used sodium silicate as the reagent providing Si whereas URAN*SYN*9 and URAN*SYN*10 used silicic acid.

The following amounts of solids were dissolved in 100 ml 0.1 m HCl:

URAN*SYN*3 = .1034 g
URAN*SYN*9 = .101 g
URAN*SYN*10 = .1017 g

U contents were measured by polarography, Ca and Si contents were determined by AA, and water content was measured by gravimetry. Results are shown below.

Sample	U ppm	Si ppm	Ca ppm	water content
URAN*SYN*3	587.7	75.6	50.8	12.65%
URAN*SYN*9	513.3	74.1	48.4	12.78%
URAN*SYN*10	532.2	74.2	49.6	13.14%

* note: a lot of scatter in the U contents by polarographic analysis was observed and I would recommend that the U contents of these solutions be measured by some other means to verify these numbers (perhaps the solutions can be sent to Div 01 for ICP analysis). What do you think?

0.1 g uranophane		0.5 g uranophane
556	U	2780
46.8	Ca	234
65.6	Si	328
	Na	
	Mg	
	Fe	

All samples

Matrix ~~solution~~ of aqueous solutions = 0.1 M HCl

Approximate concentration ranges

U - 20 - ~~100~~ 150 ppm

Ca, Si, ~~Na, Mg, Fe~~ - 1 - 20 ppm

Na, Mg, Fe - below detection limit - 5 ppm

Standards			
U =	50	90	140
Ca =	10	8	5
Si =	15	7	10
Na =	0	1	3
Mg =			
Fe =			

Distribution List

Serial Number 8939

SwRI
Division 1

D, JOANN
CUMMINS, WAYNE
DAMMANN, MIKE
LOGIN AREA
METALS PREP LAB
PRIKRYL, JAMES
SPIES, RADONNA
UHLAND, BILL

Number of Copies: 8

Number of Work Orders: 8

Date Printed: 04/25/96

Southwest Research Institute

Laboratory Work Order

Serial Number 8939

VTSR: 25 April 96

Time: 15:10

Project: 20-5708-573
Case #: DIV 20
SDG : 20 A1
t: DIV 20

Manager: PRIKRYL, JAMES
Logged in by: RPRESAS
Creation Date: 25 April 96

Checked by: SCT 4/26/96

Notes

SAMPLES RECEIVED AT ROOM TEMP.

QC NOTE: AS PER QAPP.

PARAMETERS: U, Ca, Si, Na, BY ICP.

NOTE: FOR FURTHER INFORMATION PLEASE SEE PROJECT MANAGER.

NOTIFY AND SEND RESULTS TO JIM PRIKRYL @ EXT. 5667 AT DIV 20, BLDG 57.

NOTE: OUTSIDE OF CONTAINERS WERE SCREENED FOR RADIOACTIVITY. ALL WERE BELOW BACKGROUND. BUT BECAUSE OF THE RADIOACTIVE STICKERS ON THE SAMPLE BOTTLES, THEY WILL BE STORED IN LAB 101.

System ID	#	QC	Customer ID	CED	Matrix	Required Analyses
70230	1		20 A1	/ /	LIQUID	CA, NA, SI, U-ICP
70231	1		20 A2	/ /	LIQUID	CA, NA, SI, U-ICP
70232	1		20 A3	/ /	LIQUID	CA, NA, SI, U-ICP
70233	1		20 A4	/ /	LIQUID	CA, NA, SI, U-ICP
70234	1		20 A5	/ /	LIQUID	CA, NA, SI, U-ICP
70235	1		20 A6	/ /	LIQUID	CA, NA, SI, U-ICP
70236	1		20 A7	/ /	LIQUID	CA, NA, SI, U-ICP
70237	1		20 A8	/ /	LIQUID	CA, NA, SI, U-ICP
70238	1		20 A9	/ /	LIQUID	CA, NA, SI, U-ICP
70239	1		20 AA	/ /	LIQUID	CA, NA, SI, U-ICP
70240	1		20 AB	/ /	LIQUID	CA, NA, SI, U-ICP
70241	1		20 AC	/ /	LIQUID	CA, NA, SI, U-ICP
						Samples: 12

Data must be to QA..... 06 May 96
Absolute Latest Date..... 08 May 96

Samples Received to Date: 012
Turnaround time is 14 Days from VTSR.

Date Printed: 26 April 96

Time Printed: 08:38:33

Work Orders in this SDG:

* - Indicates work group contains an MS/MSD

Thermometer: 2
Temperature: 22

ver (06/16/95)

Test Code Key

Southwest Research Institute

Serial Number 8939

VTSR: 25 April 96 Time: 15:10

Project: 20-5708-573
Case #: DIV 20
BDG : 20 A1
Client: DIV 20

Manager: PRIKRYL, JAMES

NOTES

SAMPLES RECEIVED AT ROOM TEMP.

QC NOTE: AS PER QAPP.

PARAMETERS: U, Ca, Si, Na, BY ICP.

NOTE: FOR FURTHER INFORMATION PLEASE SEE PROJECT MANAGER.

NOTIFY AND SEND RESULTS TO JIM PRIKRYL @ EXT. 5667 AT DIV 20, BLDG 57.

NOTE: OUTSIDE OF CONTAINERS WERE SCREENED FOR RADIOACTIVITY. ALL WERE BELOW BACKGROUND. BUT BECAUSE OF THE RADIOACTIVE STICKERS ON THE SAMPLE BOTTLES, THEY WILL BE STORED IN LAB 101.

Group	Test	Start	Method Date	Deadline	Number	Description	Fridge	Shelf
METALS	CA	vtsr	*10/22/96*	05/06/96	12	CA BY ICP	LAB101	SHLF
METALS	NA	vtsr	*10/22/96*	05/06/96	12	ANALYSIS FOR SODIUM BY ICP	LAB101	SHLF
METALS	SI	vtsr	*10/22/96*	05/06/96	12	SILICON BY ICP	LAB101	SHLF
METALS	U-ICP	vtsr	*10/22/96*	05/06/96	12	URANIUM BY ICP.	LAB101	SHLF

Data Must be to QA Unit..... 06 May 96

Absolute Latest Date..... 08 May 96

Date Printed: 04/26/96

Time Printed: 08:39:36

Sample List/Chain of Custody

Southwest Research Institute
Chemistry and Chemical Engineering Division
San Antonio, Texas

Page 1 of 2

Installation I.D.	Project No.
Div 20	20-5708-573

Site I.D.	Zone I.D.	Sampling Co.

Airbill No.	Shipping Container No.

Parameters ( ) / Preservation [ ]

Indicate number of sample containers per analytical method

Sample I.D.	Sample Collection Date (mm/dd/yy)	Sample Collection Time (24 Hr)	Matrix Type	Sample Type	# of Containers	[redacted]	[redacted]	U, Ca, Si, Na by ICP									Remarks
20 A1			0.1M HCl	Aqueous	1			✓									Notify and
20 A2					1			✓									Send results
20 A3					1			✓									to Jim Prikryl
20 A4					1			✓									x5667 at
20 A5					1			✓									Div 20, Bldg 57
20 A6					1			✓									Approximate conc.
20 A7					1			✓									ranges -
20 A8					1			✓									U - 20 to 150 ppm
20 A9					1			✓									Ca, Si - 1 to 20 ppm
20 AA					1			✓									Na - 0 to 5 ppm

Preservation: **a** = HCl to pH <2; **b** = HNO_3 to pH < 2; **c** = H_2SO_4 to pH < 2; **d**= NaOH to pH > 12; **e** = Other (Specify)

Relinquished by Sampler: (Signature)	Date	Time	Received by: (Signature)	Laboratory:	
James [illegible]	4/25/96	1510			
Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Samples Disposed by:	
Relinquished by: (Signature)	Date	Time	Received by Lab: (Signature)	Date	Time
			R. P.	4/25/96	1510

Matrix Types: **A** - Air; **P** - Product; **S**- Soil; **T** - Tissue; **W** - Water

Sample Types: **DM** - Dissolved Metals; **ER** - Equipment Rinsate; **FB** - Field Blank; **MD** - Matrix Spike Duplicate; **MS** - Matrix Spike; **TB** - Trip Blank; **TM** - Total Metals; **ES** - Environmental Samples

Sample List/Chain of Custody

Southwest Research Institute
Chemistry and Chemical Engineering Division
San Antonio, Texas

Installation I.D.	Project No.
Div 20	20-5706-573

Site I.D.	Zone I.D.	Sampling Co.

Airbill No.	Shipping Container No.

Sample I.D.	Sample Collection Date (mm/dd/yy)	Sample Collection Time (24 Hr)	Matrix Type	Sample Type	# of Containers	Parameters ( ) / Preservation [ ] Tarns: Na, Ca, Si, Mg, Cl, SO4, ICP	Remarks
20AB			0.1M HCl	Aqueous	1	✓	2 week turnaround requested
20AC			1	1	1	✓	

Indicate number of sample containers per analytical method

Preservation: **a** = HCl to pH <2; **b** = HNO_3 to pH < 2; **c** = H_2SO_4 to pH < 2; **d**= NaOH to pH > 12; **e** = Other (Specify)

Relinquished by Sampler: (Signature)	Date	Time	Received by: (Signature)	Laboratory:	
James D. Pry	4/25/96	1510			
Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Samples Disposed by:	
Relinquished by: (Signature)	Date	Time	Received by Lab: (Signature)	Date	Time
			RP	4/25/96	15:06

Matrix Types: **A** - Air; **P** - Product; **S**- Soil; **T** - Tissue; **W** - Water

Sample Types: **DM** - Dissolved Metals; **ER** - Equipment Rinsate; **FB** - Field Blank; **MD** - Matrix Spike Duplicate; **MS** - Matrix Spike; **TB** - Trip Blank; **TM** - Total Metals; **ES** - Environmental Samples

Southwest Research Institute
Traffic Report
Sample Custodian Signature: R. Pleser

Date: 04/25/96
Project: 20-5708-573
CASE #: DIV 20 / SDG: 20 A1
Airbill: HAND CARRIED
Work Order #: 0000008939

1. Custody Seal — Not Present or Damaged
2. Chain of Custody — Present
3. Sample Tags — Not Present
   Sample Tag Numbers — Not on COC
4. SMO Forms — Not Present

Date RecD	Time RecD	COC Record #	SMO Sample #	Corresponding		TFIC RPT, TAGS, COC AGREE Y/N	Cond of Sample
				Sample Tag #	SwRI Lab #		
04/25/96	15:10	NONE	20 A1	NONE	70230		INTACT
04/25/96	15:10	NONE	20 A2	NONE	70231		INTACT
04/25/96	15:10	NONE	20 A3	NONE	70232		INTACT
04/25/96	15:10	NONE	20 A4	NONE	70233		INTACT
04/25/96	15:10	NONE	20 A5	NONE	70234		INTACT
04/25/96	15:10	NONE	20 A6	NONE	70235		INTACT
04/25/96	15:10	NONE	20 A7	NONE	70236		INTACT
04/25/96	15:10	NONE	20 A8	NONE	70237		INTACT
04/25/96	15:10	NONE	20 A9	NONE	70238		INTACT
04/25/96	15:10	NONE	20 AA	NONE	70239		INTACT
04/25/96	15:10	NONE	20 AB	NONE	70240		INTACT
04/25/96	15:10	NONE	20 AC	NONE	70241		INTACT

SOUTHWEST RESEARCH INSTITUTE

CHAIN OF CUSTODY

DIV. 20
Client

Address

City State/Zip

Attention Telephone #

Sampled by:

Requested Turnaround:
- ☐ 1 Week
- ☒ 2 Weeks (Normal)
- ☐ 3 Weeks
- ☐ Other:

WO No.:

Project No.: 20-5704-152

Project Manager: BILL MURPHY
Jim Pritchard x5667

Sample ID	Date Sampled	Time Sampled	Matrix	# of Containers	Preservative	pH	Sample Condition	Analyses Requested
20P			Solids ~~Liq~~	1			INTACT	Full ICP + TOTAL URANIUM
20Q				1				
20R				1				
20S				1				
20T				1				
20U				1				
20V				1				
20W				1				

Relinquished by:	Date/Time:	Received by:	Date/Time:	Relinquished by:	Date/Time	Comments:
Jim Pritchard		[illegible]	1520 11-1-95			Send results to Jim Pritchard. Also send results of standards for QC
Received by:	Date/Time:	Relinquished by:	Date/Time:	Received by:	Date/Time	

P-1002

3/6/96

12.9644
12.7124
.2520

12.9644
12.9322
.0322

H_2O ~~calcul~~ measurements

after heating

Wt of qt crucible = 12.712 g
Wt URAN + SYN #9 + qtz crucible = 12.9644 g
Wt = .2520

12.9322
12.78%

Wt crucible = 11.6722 g
Wt URAN + SYN #10 + crucible = 11.9226 g
Wt = .2504

11.8897
.0329 13.14%

Wt crucible = 12.5063 g
Wt SODD + SYN #7 + crucible = 12.7701 g
wt = .2638

12.7515
.0186
7.05%

Wt crucible = 12.2499 g
wt SODD + SYN #8 + crucible = 12.5102 g
wt = .2603

12.4901
7.72%

SODD + SYN #11
URAN + SYN #3

wt crucible = 12.7085 g
wt SODD + Syn #11 + crucible = 12.9632 g
wt =

9585

50

wt crucible 12.2511
wt URAN SYN 3 + crucible = 12.5054
wt =

Standards - 3 2 make up 1 NIST
Samples 4

20 P	- URAN*SYN*9	9+10
20 Q	- URAN*SYN*10	10A
20 R	- standard 80/20	
20 S	- URAN*SYN*9	9+10
20 T	- ~~NIST~~	~~90/10~~ 50/50
20 U	- standard 90/10	~~9A+10A~~
20 V	- URAN*SYN*10	9A+10A
20 W	- URAN*SYN*9	9A

SOUTHWEST RESEARCH INSTITUTE

6220 CULEBRA ROAD • POST OFFICE DRAWER 28510 • SAN ANTONIO, TEXAS, USA 78228-0510 • (210) 684-5111 • TELEX 244846

December 5, 1995

Mr. James Prikyrl
Division 20
Southwest Research Institute

Subject: Project 20-5704-152
Metals by ICP and Total Uranium Analyses
Work Order Number: 7939
Samples Received: November 01, 1995

Dear Mr. Prikyrl:

Enclosed please find the sample results and QC sample results for the above referenced project. If you should have any questions, please contact me at 210-522-2169.

Sincerely,

Jo Ann Boyd
QAU Group Leader

TECHNICAL APPROVAL:

Mike Dammann
Inorganic Group Leader

JAB:

SwRI Case Narrative
Division 20 SDG:20P

1. Fourteen (8) Samples for ICP and U-Total Analysis:

SwRI ID	Customer ID
62301	20P
62302	20Q
62303	20R
62304	20S
62305	20T
62306	20U
62307	20V
62308	20W

2. Samples were received at SwRI on November 01, 1995 for a 14 day turnaround time from Validated Time of Sample Receipt (VTSR).

METHODOLOGY OF ANALYSIS:

The major oxides were analyzed using a "whole rock" procedure that entails a complete dissolution of the samples followed by ICAP analysis for the major species. The chemical dissolution of samples was done by an HCL/HNO_3/HF acid digestion in a teflon bomb. The digestion products were brought to a known volume using a 4% Boric acid solution to complex any excess HF and were heated again to dissolve any fluoride salts. The final solution was analyzed for major constituents utilizing a simultaneous ICAP with an internal standard. Calibration was performed using NBS certified rock standards, NIST SRM278 and NIST SRM688. The loss on ignition was done by gravimetry at 1000 C. The result for the major species were reported as their oxides.

"I certify that this data package is in compliance with the terms and conditions of the contract, both technically and for completeness, for other than the conditions detailed above. Release of the data contained in this hardcopy data package has been authorized by the Director or his designee, as verified by the following signature."

Jo Ann Boyd 12/5/95

Jo Ann Boyd, Date
Group Leader
Quality Assurance Unit,
Division 01

SOUTHWEST RESEARCH INSTITUTE
SAMPLE ANALYSIS DATA SHEET

Lab Name: Southwest Research Institute Client: Division 20

Lab Code: SWRI Date Received: 11/01/95

Lab System ID: 62301 Project No.: 20-5704-152

Sample ID	Analysis	Sample Result
20P	Si as SiO_2	15.658%
	Al as Al_2O_3	<0.001%
	Fe as Fe_2O_3	0.009%
	Mg as MgO	0.155%
	Ca as CaO	6.593%
	Na as Na_2O	<0.001%
	K as K_2O	0.001%
	Ti as TiO_2	0.054%
	Mn as MnO	0.001%
	Ba as BaO	0.002%
	Cr as Cr_2O_3	<0.001%
	Cu as CuO	0.004%
	Li as Li_2O	0.001%
	Mo as MoO_3	0.007%
	Ni as NiO	<0.001%
	P as P_2O_5	0.152%
	Pb as PbO	<0.001%
	Sr as SrO	<0.001%
	V as V_2O_5	<0.001%
	Zn as ZnO	0.001%
	Co as CoO	0.002%
	U as U_3O_8	58.974%
	LOI(Loss at 1000°C)	12.510%
	TOTAL	94.124%

SOUTHWEST RESEARCH INSTITUTE
SAMPLE ANALYSIS DATA SHEET

Lab Name: Southwest Research Institute

Client: Division 20

Lab Code: SWRI

Date Received: 11/01/95

Lab System ID: 62302

Project No.: 20-5704-152

Sample ID	Analysis	Sample Result
20Q	Si as SiO_2	15.945%
	Al as Al_2O_3	<0.001%
	Fe as Fe_2O_3	0.011%
	Mg as MgO	0.190%
	Ca as CaO	6.562%
	Na as Na_2O	<0.001%
	K as K_2O	<0.001%
	Ti as TiO_2	0.052%
	Mn as MnO	0.001%
	Ba as BaO	<0.001%
	Cr as Cr_2O_3	<0.001%
	Cu as CuO	0.004%
	Li as Li_2O	0.001%
	Mo as MoO_3	0.007%
	Ni as NiO	0.003%
	P as P_2O_5	0.167%
	Pb as PbO	<0.001%
	Sr as SrO	<0.001%
	V as V_2O_5	<0.001%
	Zn as ZnO	0.001%
	Co as CoO	<0.001%
	U as U_3O_8	58.478%
	LOI(Loss at 1000°C)	12.750%
	TOTAL	94.172%

SOUTHWEST RESEARCH INSTITUTE
SAMPLE ANALYSIS DATA SHEET

Lab Name: Southwest Research Institute Client: Division 20

Lab Code: SWRI Date Received: 11/01/95

Lab System ID: 62303 Project No.: 20-5704-152

Sample ID	Analysis	Sample Result	Duplicate Result
20R	Si as SiO_2	5.683%	5.774%
	Al as Al_2O_3	<0.001%	<0.001%
	Fe as Fe_2O_3	0.003%	0.001%
	Mg as MgO	0.165%	0.113%
	Ca as CaO	<0.001%	<0.001%
	Na as Na_2O	4.731%	4.982%
	K as K_2O	<0.001%	<0.001%
	Ti as TiO_2	0.045%	0.045%
	Mn as MnO	0.001%	0.001%
	Ba as BaO	0.012%	<0.001%
	Cr as Cr_2O_3	<0.001%	<0.001%
	Cu as CuO	0.004%	0.004%
	Li as Li_2O	0.001%	<0.001%
	Mo as MoO_3	0.007%	0.008%
	Ni as NiO	<0.001%	0.002%
	P as P_2O_5	0.015%	0.140%
	Pb as PbO	<0.001%	<0.001%
	Sr as SrO	<0.001%	<0.001%
	V as V_2O_5	<0.001%	<0.001%
	Zn as ZnO	<0.001%	0.003%
	Co as CoO	0.003%	<0.001%
	U as U_3O_8	54.361%	55.865%
	LOI	25.840%	25.840%
	TOTAL	91.005%	92.779%

SOUTHWEST RESEARCH INSTITUTE
SAMPLE ANALYSIS DATA SHEET

Lab Name: Southwest Research Institute

Client: Division 20

Lab Code: SWRI

Date Received: 11/01/95

Lab System ID: 62304

Project No.: 20-5704-152

Sample ID	Analysis	Sample Result
20S	Si as SiO_2	15.455%
	Al as Al_2O_3	<0.001%
	Fe as Fe_2O_3	0.006%
	Mg as MgO	0.265%
	Ca as CaO	6.436%
	Na as Na_2O	<0.001%
	K as K_2O	0.003%
	Ti as TiO_2	0.052%
	Mn as MnO	0.001%
	Ba as BaO	0.001%
	Cr as Cr_2O_3	<0.001%
	Cu as CuO	0.004%
	Li as Li_2O	0.001%
	Mo as MoO_3	0.001%
	Ni as NiO	0.001%
	P as P_2O_5	0.173%
	Pb as PbO	<0.001%
	Sr as SrO	<0.001%
	V as V_2O_5	<0.001%
	Zn as ZnO	<0.001%
	Co as CoO	<0.001%
	U as U_3O_8	59.099%
	LOI(Loss at 1000°C)	13.020%
	TOTAL	94.517%

SOUTHWEST RESEARCH INSTITUTE
SAMPLE ANALYSIS DATA SHEET

Lab Name: Southwest Research Institute

Client: Division 20

Lab Code: SWRI

Date Received: 11/01/95

Lab System ID: 62305

Project No.: 20-5704-152

Sample ID	Analysis	Sample Result
20T	Si as SiO_2	15.092%
	Al as Al_2O_3	<0.001%
	Fe as Fe_2O_3	0.002%
	Mg as MgO	0.181%
	Ca as CaO	0.001%
	Na as Na_2O	14.481%
	K as K_2O	0.002%
	Ti as TiO_2	0.032%
	Mn as MnO	<0.001%
	Ba as BaO	<0.001%
	Cr as Cr_2O_3	<0.001%
	Cu as CuO	0.003%
	Li as Li_2O	<0.001%
	Mo as MoO_3	0.005%
	Ni as NiO	0.005%
	P as P_2O_5	0.122%
	Pb as PbO	<0.001%
	Sr as SrO	<0.001%
	V as V_2O_5	<0.001%
	Zn as ZnO	0.003%
	Co as CoO	0.005%
	U as U_3O_8	39.324%
	LOI(Loss at 1000°C)	25.410%
	TOTAL	94.667%

SOUTHWEST RESEARCH INSTITUTE
SAMPLE ANALYSIS DATA SHEET

Lab Name: Southwest Research Institute

Client: Division 20

Lab Code: SWRI

Date Received: 11/01/95

Lab System ID: 62306

Project No.: 20-5704-152

Sample ID	Analysis	Sample Result
20U	Si as SiO_2	3.240%
	Al as Al_2O_3	<0.001%
	Fe as Fe_2O_3	0.002%
	Mg as MgO	0.255%
	Ca as CaO	0.008%
	Na as Na_2O	2.630%
	K as K_2O	<0.001%
	Ti as TiO_2	0.053%
	Mn as MnO	0.001%
	Ba as BaO	0.002%
	Cr as Cr_2O_3	<0.001%
	Cu as CuO	0.005%
	Li as Li_2O	0.001%
	Mo as MoO_3	0.014%
	Ni as NiO	0.001%
	P as P_2O_5	0.193%
	Pb as PbO	<0.001%
	Sr as SrO	<0.001%
	V as V_2O_5	<0.001%
	Zn as ZnO	0.001%
	Co as CoO	<0.001%
	U as U_3O_8	65.497%
	LOI(Loss at 1000°C)	24.740%
	TOTAL	96.642%

SOUTHWEST RESEARCH INSTITUTE
SAMPLE ANALYSIS DATA SHEET

Lab Name: Southwest Research Institute Client: Division 20

Lab Code: SWRI Date Received: 11/01/95

Lab System ID: 62307 Project No.: 20-5704-152

Sample ID	Analysis	Sample Result
20V	Si as SiO_2	16.732%
	Al as Al_2O_3	<0.001%
	Fe as Fe_2O_3	0.003%
	Mg as MgO	0.231%
	Ca as CaO	6.087%
	Na as Na_2O	<0.001%
	K as K_2O	0.002%
	Ti as TiO_2	0.051%
	Mn as MnO	0.001%
	Ba as BaO	0.005%
	Cr as Cr_2O_3	<0.001%
	Cu as CuO	0.003%
	Li as Li_2O	0.001%
	Mo as MoO_3	0.012%
	Ni as NiO	0.001%
	P as P_2O_5	0.170%
	Pb as PbO	<0.001%
	Sr as SrO	<0.001%
	V as V_2O_5	<0.001%
	Zn as ZnO	0.001%
	Co as CoO	0.001%
	U as U_3O_8	57.416%
	LOI(Loss at 1000°C)	12.740%
	TOTAL	93.457%

SOUTHWEST RESEARCH INSTITUTE
SAMPLE ANALYSIS DATA SHEET

Lab Name: Southwest Research Institute

Client: Division 20

Lab Code: SWRI

Date Received: 11/01/95

Lab System ID: 62308

Project No.: 20-5704-152

Sample ID	Analysis	Sample Result
20W	Si as SiO_2	16.163%
	Al as Al_2O_3	<0.001%
	Fe as Fe_2O_3	0.008%
	Mg as MgO	0.173%
	Ca as CaO	6.225%
	Na as Na_2O	<0.001%
	K as K_2O	<0.001%
	Ti as TiO_2	0.052%
	Mn as MnO	0.001%
	Ba as BaO	<0.001%
	Cr as Cr_2O_3	<0.001%
	Cu as CuO	0.004%
	Li as Li_2O	0.001%
	Mo as MoO_3	0.010%
	Ni as NiO	0.002%
	P as P_2O_5	0.195%
	Pb as PbO	<0.001%
	Sr as SrO	<0.001%
	V as V_2O_5	<0.001%
	Zn as ZnO	<0.001%
	Co as CoO	0.005%
	U as U_3O_8	58.151%
	LOI(Loss at 1000°C)	13.070%
	TOTAL	94.059%

SOUTHWEST RESEARCH INSTITUTE
SAMPLE ANALYSIS DATA SHEET

Lab Name: Southwest Research Institute Client: Division 20

Lab Code: SWRI Date Received: 11/01/95

Lab System ID: NA Project No.: 20-5704-152

Sample ID	Analysis	Beginng of Run	End of Run
278	Si as SiO_2	74.222%	72.831%
	Al as Al_2O_3	13.831%	14.880%
	Fe as Fe_2O_3	2.106%	2.120%
	Mg as MgO	0.230%	0.252%
	Ca as CaO	0.983%	0.952%
	Na as Na_2O	4.684%	5.274%
	K as K_2O	4.044%	4.546%
	Ti as TiO_2	0.241%	0.247%
	Mn as MnO	0.050%	0.050%
	Ba as BaO	0.101%	0.105%
	Cr as Cr_2O_3	0.001%	0.001%
	Cu as CuO	0.001%	0.001%
	Li as Li_2O	0.010%	0.011%
	Mo as MoO_3	0.001%	0.001%
	Ni as NiO	0.002%	<0.001%
	P as P_2O_5	0.072%	0.057%
	Pb as PbO	0.005%	0.003%
	Sr as SrO	0.004%	0.004%
	V as V_2O_5	0.002%	0.002%
	Zn as ZnO	0.007%	0.007%
	Co as CoO	0.001%	0.002%
	U as U_3O_8	<0.001%	<0.001%
	LOI(Loss at 1000°C)	<0.001%	<0.001%
	TOTAL	100.596%	101.347%

SOUTHWEST RESEARCH INSTITUTE
SAMPLE ANALYSIS DATA SHEET

Lab Name: Southwest Research Institute Client: Division 20

Lab Code: SWRI Date Received: 11/01/95

Lab System ID: NA Project No.: 20-5704-152

Sample ID	Analysis	Beginning of Run	End of Run
688	Si as SiO_2	50.783%	49.463%
	Al as Al_2O_3	17.425%	19.243%
	Fe as Fe_2O_3	10.389%	10.304%
	Mg as MgO	8.389%	8.924%
	Ca as CaO	12.270%	11.455%
	Na as Na_2O	2.010%	2.442%
	K as K_2O	0.177%	0.215%
	Ti as TiO_2	1.172%	1.194%
	Mn as MnO	0.160%	0.158%
	Ba as BaO	0.018%	0.019%
	Cr as Cr_2O_3	0.046%	0.044%
	Cu as CuO	0.013%	0.014%
	Li as Li_2O	0.001%	0.001%
	Mo as MoO_3	<0.001%	<0.001%
	Ni as NiO	0.020%	0.017%
	P as P_2O_5	0.198%	0.184%
	Pb as PbO	0.006%	<0.001%
	Sr as SrO	0.010%	0.011%
	V as V_2O_5	0.052%	0.052%
	Zn as ZnO	0.010%	0.009%
	Co as CoO	0.010%	0.014%
	U as U_3O_8	<0.001%	<0.001%
	LOI(Loss at 1000°C)	<0.001%	<0.001%
	TOTAL	103.159%	103.762%

Distribution List

Serial Number 7264

SwRI
Division 1

YD, JOANN
CUMMINS, WAYNE
DAMMANN, MIKE
LOGIN AREA
PRIKRYL, JAMES — D/V20
SPIES, RADONNA
WARD, JEFF

Number of Copies: 7

Date Printed: 07/13/95

Number of Work Orders: 7

Southwest Research Institute

Laboratory Work Order

Serial Number 7264

VTSR: 13 July 95

Time: 14:25

Project: 20-5704-152
Case #: DIV 20
SDG : 56762
[illegible]nt: DIV 20

Manager: PRIKRYL, JAMES
Logged in by: JMORIN
Creation Date: 13 July 95

Checked by: SL 7/14/95

Notes

SAMPLES RECEIVED AT ROOM TEMP.
^GIVE SRK 7/14/95

QC NOTE: PLEASE ACCOUNTING OF QC AND PROCEDURES, ALSO RESULTS OF QC SAMPLES.

PARAMETERS: FULL ICP AND URANIUM ANALYSIS.

NOTE: SEE PROJECT MANAGER FOR FURTHER DETAILS.

System ID	#	QC	Customer ID	CED	Matrix	Required Analyses
56762	1		20A	/ /	SOLID	ICP, U-TOTAL
56763	1		20B	/ /	SOLID	ICP
56764	1		20C	/ /	SOLID	ICP, U-TOTAL
56765	1		20D	/ /	SOLID	ICP, U-TOTAL
56766	1		20E	/ /	SOLID	ICP
56767	1		20F	/ /	SOLID	ICP
56768	1		20G	/ /	SOLID	ICP, U-TOTAL
56769	1		20H	/ /	SOLID	ICP
56770	1		20I	/ /	SOLID	ICP
56771	1		20J	/ /	SOLID	ICP
56772	1		20K	/ /	SOLID	ICP
56773	1		20L	/ /	SOLID	ICP
56774	1		20M	/ /	SOLID	ICP
56775	1		20N	/ /	SOLID	ICP
						Samples: 14

Data must be to QA..... 24 July 95
Absolute Latest Date..... 26 July 95

Samples Received to Date: 014
Turnaround time is 14 Days from VTSR.

Date Printed: 13 July 95

Time Printed: 16:36:11

Work Orders in this SDG:

7264

* - Indicates work group contains an MS/MSD

Thermometer: 2
Temperature: 22.0

ver (06/16/95)

Southwest Research Institute

Test Code Key

Serial Number 7264

VTSR: 13 July 95 Time: 14:25

Manager: PRIKRYL, JAMES

Project: 20-5704-152
Case #: DIV 20
DG : 56762
Client: DIV 20

NOTES

SAMPLES RECEIVED AT ROOM TEMP.

QC NOTE: PLEASE ACCOUNTING OF QC AND PROCEDURES, ALSO RESULTS OF QC SAMPLES.

PARAMETERS: FULL ICP AND URANIUM ANALYSIS.

NOTE: SEE PROJECT MANAGER FOR FURTHER DETAILS.

Group	Test	Start	Method Date	Deadline	Number	Description	Fridge	Shelf
METALS	ICP	vtsr	*01/09/96*	07/24/95	14	ANALYSIS BY ICP	LAB28	CT
METALS	U-TOTAL	vtsr	*01/09/96*	07/24/95	4	TOTAL URANIUM (FLUOROMETRIC)	LAB101	CT

Data Must be to QA Unit..... 24 July 95

Absolute Latest Date..... 26 July 95

Date Printed: 07/13/95

Time Printed: 16:36:25

SOUTHWEST RESEARCH INSTITUTE

CHAIN OF CUSTODY

DIV. 20
Client

Bill To:

Job No:

Address

Project No: 20 5704-152

City State/Zip

Sampled by:

Facility Name:

Attention Telephone #

Requested Turn Around:
☐ 1 Week ☒ 2 Weeks (Normal) ☐ 3 Weeks ☐ Other:

APPROVED:

SwRI ID	Date Sampled	Time Sampled	Matrix	# of Containers	Pres	pH	Sample Condition	Analyses Requested
20A			SOLID	1			INTACT	Full METALS/MATRIX
B				1				
C				1				
D				1				
E				1				
F				1				
G				1				
H				1				
I				1				
J				1				

1. Relinquished By:	Date/Time:	1. Received By:	Date/Time:	3. Relinquinshed by:	Date/Time	Sample Location: EXT. 5667
2. Relinquished By:	Date/Time:	2. Received By:	Date/Time:	4. Relinquinshed by:	Date/Time	Comments: James R Bobby 5304

SOUTHWEST RESEARCH INSTITUTE

CHAIN OF CUSTODY

Div. 20
Client

Bill To: _____

Job No: _____

Address

Project No: 20-5704-152

City State/Zip

Sampled by: _____

Facility Name: _____

Attention Telephone #

Requested Turn Around:
☐ 1 Week ☒ 2 Weeks (Normal) ☐ 3 Weeks ☐ Other: _____

APPROVED: _____

SwRI ID	Date Sampled	Time Sampled	Matrix	# of Containers	Pres	pH	Sample Condition	Analyses Requested
20 K			SOLID	1	–	–	INTACT	FULL ICP
L				1	–	–		
M				1	–	–		
N				1	–	–		

1. Relinquished By:	Date/Time:	1. Received By:	Date/Time:	3. Relinquinshed by:	Date/Time
[illegible]	7-13-95	Joe Moun[illegible]	14:25 7-13-95		
2. Relinquished By:	**Date/Time:**	**2. Received By:**	**Date/Time:**	**4. Relinquinshed by:**	**Date/Time**

Sample Location: QC

Comments: [illegible] accounting of [illegible] and results of QC samples

Southwest Research Institute
Traffic Report
Sample Custodian Signature: Joel Morrison 7-13-95

Date: 07/13/95
Project: 20-5704-152
CASE #: DIV 20 / SDG: 56762
Airbill: HAND CARRIED
Work Order #: 0000007264

1. Custody Seal — Not Present or Damaged
2. Chain of Custody — Present
3. Sample Tags — Not Present
   Sample Tag Numbers — Not on COC
4. SMO Forms — Not Present

Date RecD	Time RecD	COC Record #	SMO Sample #	Corresponding		TFIC RPT, TAGS, COC AGREE Y/N	Cond of Sample
				Sample Tag #	SwRI Lab #		
07/13/95	14:25	NONE	20A	NONE	56762		INTACT
07/13/95	14:25	NONE	20B	NONE	56763		INTACT
07/13/95	14:25	NONE	20C	NONE	56764		INTACT
07/13/95	14:25	NONE	20D	NONE	56765		INTACT
07/13/95	14:25	NONE	20E	NONE	56766		INTACT
07/13/95	14:25	NONE	20F	NONE	56767		INTACT
07/13/95	14:25	NONE	20G	NONE	56768		INTACT
07/13/95	14:25	NONE	20H	NONE	56769		INTACT
07/13/95	14:25	NONE	20I	NONE	56770		INTACT
07/13/95	14:25	NONE	20J	NONE	56771		INTACT
07/13/95	14:25	NONE	20K	NONE	56772		INTACT
07/13/95	14:25	NONE	20L	NONE	56773		INTACT
07/13/95	14:25	NONE	20M	NONE	56774		INTACT
07/13/95	14:25	NONE	20N	NONE	56775		INTACT

Expected and measured values of synthetic uranophane

	Expected	20A	20C	20D	20G
Si as SiO_2	14.02%	16.6/16.8%	17.5%	17.5%	17.5%
Ca as CaO	6.55%	6.31/6.32%	6.53%	6.47%	6.22%
U as U_3O_8	65.57%	60.0/60.1%	62.2%	61.1%	58.5%

Expected and measured values of standards

	Expected	20B		Expected	20E
Si as SiO_2	72.7%	74.7%		59.6%	67.2%
Al as Al_2O_3	13.8%	12.6%		18.5%	18.7%
Ca as CaO	1.13%	1.06%		1.10%	1.11%
Na as Na_2O	4.03%	4.36%		8.91%	10.6%

	Expected	20F			
Si as SiO_2	73.05%	74.6%			
Al as Al_2O_3	14.15%	13.0%			
Ca as CaO	0.98%	0.90%			
Na as Na_2O	4.84%	5.23%			

MEMORANDUM

TO:	Jim Prikyrl Division 20
FROM:	Jo Ann Boyd Division 01
RE:	Project 20-5704-152 Metals by ICP and Total Uranium Analyses
DATE:	August 29, 1995

Enclosed please find the sample results for the above referenced project.

If there are any questions, please feel free to contact me by voice mail 522-2169 or by fax at 522-2021. I look forward to our continued analytical support of your projects.

SOUTHWEST RESEARCH INSTITUTE
SAMPLE ANALYSIS DATA SHEET FOR MAJOR METALS

Lab Name: Southwest Research Institute

Client: Division 20

Lab Code: SWRI

Date Received: 07/13/95

Lab System ID: 56762

Project No.: 20-5704-152

Sample ID	Analysis	Sample Result
20A	Si as SiO_2	16.6%
	Mg as MgO	0.300%
	Ca as CaO	6.31%
	P as P_2O_5	0.179%
	LOI (Loss @ 1000°C)	13.0%
	U as U_3O_8	60.0%
	TOTAL	96.3%

SOUTHWEST RESEARCH INSTITUTE
SAMPLE ANALYSIS DATA SHEET FOR MAJOR METALS

Lab Name: Southwest Research Institute

Client: Division 20

Lab Code: SWRI

Date Received: 07/13/95

Lab System ID: 56762D

Project No.: 20-5704-152

Sample ID	Analysis	Duplicate Result
20A	Si as SiO_2	16.8%
	Mg as MgO	0.318%
	Ca as CaO	6.32%
	P as P_2O_5	0.142%
	LOI (Loss @ 1000°C)	13.0%
	U as U_3O_8	60.1%
	TOTAL	96.6%

SOUTHWEST RESEARCH INSTITUTE
SAMPLE ANALYSIS DATA SHEET FOR MAJOR METALS

Lab Name: Southwest Research Institute

Client: Division 20

Lab Code: SWRI

Date Received: 07/13/95

Lab System ID: 56763

Project No.: 20-5704-152

Sample ID	Analysis	Sample Result
20B	Si as SiO_2	74.7%
	Al as Al_2O_3	12.6%
	Fe as Fe_2O_3	1.72%
	Mg as MgO	0.251%
	Ca as CaO	1.06%
	Na as Na_2O	4.36%
	K as K_2O	4.58%
	Ti as TiO_2	0.248%
	LOI (Loss @ 1000°C)	1.11%
	TOTAL	101%

SOUTHWEST RESEARCH INSTITUTE
SAMPLE ANALYSIS DATA SHEET FOR MAJOR METALS

Lab Name: Southwest Research Institute

Client: Division 20

Lab Code: SWRI

Date Received: 07/13/95

Lab System ID: 56764

Project No.: 20-5704-152

Sample ID	Analysis	Sample Result
20C	Si as SiO_2	17.5%
	Mg as MgO	0.417%
	Ca as CaO	6.53%
	P as P_2O_5	0.176%
	LOI (Loss @ 1000°C)	12.5%
	U as U_3O_8	62.2%
	TOTAL	99.3%

SOUTHWEST RESEARCH INSTITUTE
SAMPLE ANALYSIS DATA SHEET FOR MAJOR METALS

Lab Name: Southwest Research Institute

Client: Division 20

Lab Code: SWRI

Date Received: 07/13/95

Lab System ID: 56765

Project No.: 20-5704-152

Sample ID	Analysis	Sample Result
20D	Si as SiO_2	17.5%
	Mg as MgO	0.392%
	Ca as CaO	6.47%
	P as P_2O_5	0.167%
	LOI (Loss @ 1000°C)	13.0%
	U as U_3O_8	61.1%
	TOTAL	98.6%

SOUTHWEST RESEARCH INSTITUTE
SAMPLE ANALYSIS DATA SHEET FOR MAJOR METALS

Lab Name: Southwest Research Institute

Lab Code: SWRI

Lab System ID: 56766

Client: Division 20

Date Received: 07/13/95

Project No.: 20-5704-152

Sample ID	Analysis	Sample Result
20E	Si as SiO_2	67.2%
	Al as Al_2O_3	18.7%
	Fe as Fe_2O_3	5.35%
	Ca as CaO	1.11%
	Na as Na_2O	10.6%
	K as K_2O	5.07%
	Ti as TiO_2	0.135%
	Mn as MnO	0.248%
	P as P_2O_5	0.195%
	LOI (Loss @ 1000°C)	1.70%
	TOTAL	110%

SOUTHWEST RESEARCH INSTITUTE
SAMPLE ANALYSIS DATA SHEET FOR MAJOR METALS

Lab Name: Southwest Research Institute

Client: Division 20

Lab Code: SWRI

Date Received: 07/13/95

Lab System ID: 56768

Project No.: 20-5704-152

Sample ID	Analysis	Sample Result
20G	Si as SiO_2	17.5%
	Mg as MgO	0.378%
	Ca as CaO	6.22%
	P as P_2O_5	0.159%
	LOI (Loss @ 1000°C)	12.8%
	U as U_3O_8	58.5%
	TOTAL	95.6%

SOUTHWEST RESEARCH INSTITUTE
SAMPLE ANALYSIS DATA SHEET FOR MAJOR METALS

Lab Name: Southwest Research Institute

Client: Division 20

Lab Code: SWRI

Date Received: 07/13/95

Lab System ID: 56769

Project No.: 20-5704-152

Sample ID	Analysis	Sample Result
20H	Si as SiO_2	59.6%
	Al as Al_2O_3	16.0%
	Fe as Fe_2O_3	1.41%
	Mg as MgO	5.35%
	Ca as CaO	0.803%
	Na as Na_2O	2.83%
	K as K_2O	0.144%
	Ti as TiO_2	0.195%
	Mn as MnO	0.180%
	LOI (Loss @ 1000°C)	14.9%
	TOTAL	101%

SOUTHWEST RESEARCH INSTITUTE
SAMPLE ANALYSIS DATA SHEET FOR MAJOR METALS

Lab Name: Southwest Research Institute

Client: Division 20

Lab Code: SWRI

Date Received: 07/13/95

Lab System ID: 56770

Project No.: 20-5704-152

Sample ID	Analysis	Sample Result
20I	Si as SiO_2	46.7%
	Al as Al_2O_3	12.5%
	Fe as Fe_2O_3	1.11%
	Mg as MgO	4.43%
	Ca as CaO	1.99%
	K as K_2O	0.153%
	Ti as TiO_2	0.161%
	LOI (Loss @ 1000°C)	25.5%
	TOTAL	92.6%

SOUTHWEST RESEARCH INSTITUTE
SAMPLE ANALYSIS DATA SHEET FOR MAJOR METALS

Lab Name: Southwest Research Institute

Client: Division 20

Lab Code: SWRI

Date Received: 07/13/95

Lab System ID: 56767

Project No.: 20-5704-152

Sample ID	Analysis	Sample Result
20F	Si as SiO_2	74.6%
	Al as Al_2O_3	13.0%
	Fe as Fe_2O_3	1.96%
	Mg as MgO	0.223%
	Ca as CaO	0.900%
	Na as Na_2O	5.23%
	K as K_2O	4.48%
	Ti as TiO_2	0.226%
	Ba as BaO	0.106%
	LOI (Loss @ 1000°C)	0.691%
	TOTAL	101%

SOUTHWEST RESEARCH INSTITUTE
SAMPLE ANALYSIS DATA SHEET FOR MAJOR METALS

Lab Name: Southwest Research Institute

Client: Division 20

Lab Code: SWRI

Date Received: 07/13/95

Lab System ID: 56771

Project No.: 20-5704-152

Sample ID	Analysis	Sample Result
20J	Si as SiO_2	53.5%
	Al as Al_2O_3	14.3%
	Fe as Fe_2O_3	1.27%
	Mg as MgO	4.84%
	Na as Na_2O	3.44%
	Ti as TiO_2	0.185%
	LOI (Loss @ 1000°C)	23.4%
	TOTAL	101%

SOUTHWEST RESEARCH INSTITUTE
SAMPLE ANALYSIS DATA SHEET FOR MAJOR METALS

Lab Name: Southwest Research Institute

Client: Division 20

Lab Code: SWRI

Date Received: 07/13/95

Lab System ID: 56771D

Project No.: 20-5704-152

Sample ID	Analysis	Duplicate Result
20J	Si as SiO_2	55.0%
	Al as Al_2O_3	14.8%
	Fe as Fe_2O_3	1.31%
	Mg as MgO	5.00%
	Na as Na_2O	3.61%
	Ti as TiO_2	0.190%
	LOI (Loss @ 1000°C)	23.4%
	TOTAL	103%

SOUTHWEST RESEARCH INSTITUTE
SAMPLE ANALYSIS DATA SHEET FOR MAJOR METALS

Lab Name: Southwest Research Institute

Lab Code: SWRI

Lab System ID: 56772

Client: Division 20

Date Received: 07/13/95

Project No.: 20-5704-152

Sample ID	Analysis	Sample Result
20K	Si as SiO_2	58.1%
	Al as Al_2O_3	15.3%
	Fe as Fe_2O_3	1.37%
	Mg as MgO	5.46%
	Ca as CaO	2.49%
	K as K_2O	0.191%
	Ti as TiO_2	0.199%
	LOI (Loss @ 1000°C)	25.5%
	TOTAL	109%

SOUTHWEST RESEARCH INSTITUTE

SAMPLE ANALYSIS DATA SHEET FOR MAJOR METALS

Lab Name: Southwest Research Institute

Client: Division 20

Lab Code: SWRI

Date Received: 07/13/95

Lab System ID: 56773

Project No.: 20-5704-152

Sample ID	Analysis	Sample Result
20L	Si as SiO_2	61.4%
	Al as Al_2O_3	16.7%
	Fe as Fe_2O_3	1.47%
	Mg as MgO	5.63%
	Na as Na_2O	4.07%
	Ti as TiO_2	0.213%
	LOI (Loss @ 1000°C)	24.4%
	TOTAL	114%

SOUTHWEST RESEARCH INSTITUTE

SAMPLE ANALYSIS DATA SHEET FOR MAJOR METALS

Lab Name: Southwest Research Institute

Client: Division 20

Lab Code: SWRI

Date Received: 07/13/95

Lab System ID: 56774

Project No.: 20-5704-152

Sample ID	Analysis	Sample Result
20M	Si as SiO_2	68.6%
	Al as Al_2O_3	14.4%
	Fe as Fe_2O_3	5.47%
	Mg as MgO	2.81%
	Ca as CaO	2.64%
	Na as Na_2O	1.12%
	K as K_2O	3.29%
	Ti as TiO_2	0.578%
	P as P_2O_5	0.238%
	LOI (Loss @ 1000°C)	10.0%
	TOTAL	109%

SOUTHWEST RESEARCH INSTITUTE
SAMPLE ANALYSIS DATA SHEET FOR MAJOR METALS

Lab Name: Southwest Research Institute

Client: Division 20

Lab Code: SWRI

Date Received: 07/13/95

Lab System ID: 56775

Project No.: 20-5704-152

Sample ID	Analysis	Sample Result
20N	Si as SiO_2	74.7%
	Al as Al_2O_3	14.8%
	Fe as Fe_2O_3	5.62%
	Mg as MgO	2.93%
	Ca as CaO	2.74%
	Na as Na_2O	1.19%
	K as K_2O	3.43%
	Ti as TiO_2	0.613%
	P as P_2O_5	0.271%
	LOI (Loss @ 1000°C)	10.0%
	TOTAL	116%

SOUTHWEST RESEARCH INSTITUTE

SAMPLE ANALYSIS DATA SHEET
FOR MINOR METALS

Sample ID
20A

Lab Name: Southwest Research Institute

Client: Division 20

Lab Code: SWRI

Date Received: 07/13/95

Matrix: Solid

Date Analyzed: 08/07/95

Lab System ID: 56762

Project No.: 20-5704-152

Analysis	Sample Result (ug/g)	Duplicate Result (ug/g)	Detection Limit (ug/g)
Aluminum	<10	<10	10
Antimony	<10	<10	10
Arsenic	<25	<25	25
Barium	<4	<4	4
Beryllium	<2	<2	2
Boron	<20	<20	20
Cadmium	<4	<4	4
Chromium	<4	<4	4
Cobalt	<10	<10	10
Copper	<4	<4	4
Iron	154	177	10
Lead	<10	<10	10
Lithium	<4	<4	4
Manganese	<4	<4	4
Molybdenum	<4	<4	4
Nickel	<12	<12	12
Potassium	<40	<40	40
Selenium	<10	<10	10
Silver	<10	<10	10
Sodium	<25	<25	25
Strontium	<10	<10	10
Thallium	<10	<10	10
Tin	<20	<20	20
Titanium	<8	<8	8
Vanadium	<20	<20	20
Zinc	<20	<20	20

SOUTHWEST RESEARCH INSTITUTE

SAMPLE ANALYSIS DATA SHEET
FOR MINOR METALS

Sample ID
20B

Lab Name: Southwest Research Institute

Client: Division 20

Lab Code: SWRI

Date Received: 07/13/95

Matrix: Solid

Date Analyzed: 08/07/95

Lab System ID: 56763

Project No.: 20-5704-152

Analysis	Sample Result (ug/g)	Detection Limit (ug/g)
Antimony	<10	10
Arsenic	<25	25
Barium	866	4
Beryllium	2	2
Boron	<20	20
Cadmium	<4	4
Chromium	12	4
Cobalt	<10	10
Copper	16	4
Lead	25	10
Lithium	64	4
Manganese	282	4
Molybdenum	<4	4
Nickel	<12	12
Phosphorus	126	76
Selenium	<10	10
Silver	<10	10
Strontium	106	10
Thallium	<10	10
Tin	<20	20
Vanadium	<20	20
Zinc	32	20

SOUTHWEST RESEARCH INSTITUTE

SAMPLE ANALYSIS DATA SHEET
FOR MINOR METALS

Sample ID
20C

Lab Name: Southwest Research Institute

Lab Code: SWRI

Matrix: Solid

Lab System ID: 56764

Client: Division 20

Date Received: 07/13/95

Date Analyzed: 08/07/95

Project No.: 20-5704-152

Analysis	Sample Result (ug/g)	Detection Limit (ug/g)
Aluminum	<10	10
Antimony	<10	10
Arsenic	<25	25
Barium	<4	4
Beryllium	<2	2
Boron	<20	20
Cadmium	<4	4
Chromium	<4	4
Cobalt	<10	10
Copper	<4	4
Iron	120	10
Lead	<10	10
Lithium	<4	4
Manganese	<4	4
Molybdenum	<4	4
Nickel	<12	12
Potassium	<40	40
Selenium	<10	10
Silver	<10	10
Sodium	<25	25
Strontium	<10	10
Thallium	<10	10
Tin	<20	20
Titanium	<8	8
Vanadium	<20	20
Zinc	<20	20

SOUTHWEST RESEARCH INSTITUTE

SAMPLE ANALYSIS DATA SHEET
FOR MINOR METALS

Sample ID
20D

Lab Name: Southwest Research Institute

Lab Code: SWRI

Matrix: Solid

Lab System ID: 56765

Client: Division 20

Date Received: 07/13/95

Date Analyzed: 08/07/95

Project No.: 20-5704-152

Analysis	Sample Result (ug/g)	Detection Limit (ug/g)
Aluminum	<10	10
Antimony	<10	10
Arsenic	<25	25
Barium	<4	4
Beryllium	<2	2
Boron	<20	20
Cadmium	<4	4
Chromium	<4	4
Cobalt	<10	10
Copper	<4	4
Iron	221	10
Lead	<10	10
Lithium	<4	4
Manganese	<4	4
Molybdenum	<4	4
Nickel	<12	12
Potassium	<40	40
Selenium	<10	10
Silver	<10	10
Sodium	<25	25
Strontium	<10	10
Thallium	<10	10
Tin	<20	20
Titanium	<8	8
Vanadium	<20	20
Zinc	<20	20

SOUTHWEST RESEARCH INSTITUTE

SAMPLE ANALYSIS DATA SHEET
FOR MINOR METALS

Sample ID
20E

Lab Name: Southwest Research Institute

Client: Division 20

Lab Code: SWRI

Date Received: 07/13/95

Matrix: Solid

Date Analyzed: 08/07/95

Lab System ID: 56766

Project No.: 20-5704-152

Analysis	Sample Result (ug/g)	Detection Limit (ug/g)
Antimony	<10	10
Arsenic	<25	25
Barium	598	4
Beryllium	9	2
Boron	<20	20
Cadmium	<4	4
Chromium	11	4
Cobalt	<10	10
Copper	4	4
Lead	16	10
Lithium	38	4
Magnesium	588	19
Molybdenum	<4	4
Nickel	<12	12
Selenium	<10	10
Silver	<10	10
Strontium	706	10
Thallium	<10	10
Tin	<20	20
Vanadium	<20	20
Zinc	260	20

SOUTHWEST RESEARCH INSTITUTE

SAMPLE ANALYSIS DATA SHEET
FOR MINOR METALS

Sample ID
20F

Lab Name: Southwest Research Institute

Lab Code: SWRI

Matrix: Solid

Lab System ID: 56767

Client: Division 20

Date Received: 07/13/95

Date Analyzed: 08/07/95

Project No.: 20-5704-152

Analysis	Sample Result (ug/g)	Detection Limit (ug/g)
Antimony	<10	10
Arsenic	<25	25
Beryllium	3	2
Boron	<20	20
Cadmium	<4	4
Chromium	9	4
Cobalt	<10	10
Copper	6	4
Lead	15	10
Lithium	48	4
Manganese	403	4
Molybdenum	<4	4
Nickel	<12	12
Phosphorus	115	80
Selenium	<10	10
Silver	<10	10
Strontium	65	10
Thallium	<10	10
Tin	<20	20
Vanadium	<20	20
Zinc	59	20

SOUTHWEST RESEARCH INSTITUTE

SAMPLE ANALYSIS DATA SHEET
FOR MINOR METALS

Sample ID
20G

Lab Name: Southwest Research Institute

Client: Division 20

Lab Code: SWRI

Date Received: 07/13/95

Matrix: Solid

Date Analyzed: 08/07/95

Lab System ID: 56768

Project No.: 20-5704-152

Analysis	Sample Result (ug/g)	Detection Limit (ug/g)
Aluminum	<10	10
Antimony	<10	10
Arsenic	<25	25
Barium	<4	4
Beryllium	<2	2
Boron	<20	20
Cadmium	<4	4
Chromium	<4	4
Cobalt	<10	10
Copper	<4	4
Iron	104	10
Lead	<10	10
Lithium	<4	4
Manganese	<4	4
Molybdenum	<4	4
Nickel	<12	12
Potassium	<40	40
Selenium	<10	10
Silver	<10	10
Sodium	<25	25
Strontium	<10	10
Thallium	<10	10
Tin	<20	20
Titanium	<8	8
Vanadium	<20	20
Zinc	<20	20

SOUTHWEST RESEARCH INSTITUTE

SAMPLE ANALYSIS DATA SHEET
FOR MINOR METALS

Sample ID
20H

Lab Name: Southwest Research Institute

Client: Division 20

Lab Code: SWRI

Date Received: 07/13/95

Matrix: Solid

Date Analyzed: 08/07/95

Lab System ID: 56769

Project No.: 20-5704-152

Analysis	Sample Result (ug/g)	Detection Limit (ug/g)
Antimony	<10	10
Arsenic	<25	25
Barium	266	4
Beryllium	4	2
Boron	<20	20
Cadmium	<4	4
Chromium	25	4
Cobalt	<10	10
Copper	<4	4
Lead	41	10
Lithium	256	4
Molybdenum	<4	4
Nickel	<12	12
Phosphorus	<80	80
Selenium	<10	10
Silver	<10	10
Strontium	112	10
Thallium	<10	10
Tin	<20	20
Vanadium	62	20
Zinc	75	20

SOUTHWEST RESEARCH INSTITUTE

SAMPLE ANALYSIS DATA SHEET
FOR MINOR METALS

Sample ID
20I

Lab Name: Southwest Research Institute

Lab Code: SWRI

Matrix: Solid

Lab System ID: 56770

Client: Division 20

Date Received: 07/13/95

Date Analyzed: 08/07/95

Project No.: 20-5704-152

Analysis	Sample Result (ug/g)	Detection Limit (ug/g)
Antimony	<10	10
Arsenic	<25	25
Barium	299	4
Beryllium	3	2
Boron	<20	20
Cadmium	<4	4
Chromium	9	4
Cobalt	<10	10
Copper	<4	4
Lead	26	10
Lithium	212	4
Manganese	562	4
Molybdenum	<4	4
Nickel	<12	12
Phosphorus	<80	80
Selenium	<10	10
Silver	<10	10
Sodium	605	25
Strontium	286	10
Thallium	<10	10
Tin	<20	20
Vanadium	57	20
Zinc	53	20

SOUTHWEST RESEARCH INSTITUTE

SAMPLE ANALYSIS DATA SHEET
FOR MINOR METALS

Sample ID
20J

Lab Name: Southwest Research Institute

Client: Division 20

Lab Code: SWRI

Date Received: 07/13/95

Matrix: Solid

Date Analyzed: 08/07/95

Lab System ID: 56771

Project No.: 20-5704-152

Analysis	Sample Result (ug/g)	Duplicate Result (ug/g)	Detection Limit (ug/g)
Antimony	<10	<10	10
Arsenic	<25	<25	25
Barium	53	53	4
Beryllium	4	3	2
Boron	<20	<20	20
Cadmium	<4	<4	4
Calcium	253	251	20
Chromium	8	12	4
Cobalt	<10	<10	10
Copper	<4	<4	4
Lead	26	29	10
Lithium	226	229	4
Manganese	263	263	4
Molybdenum	<4	<4	4
Nickel	<12	<12	12
Phosphorus	<80	<80	80
Potassium	530	550	40
Selenium	<10	<10	10
Silver	<10	<10	10
Strontium	<10	<10	10
Thallium	<10	<10	10
Tin	<20	<20	20
Vanadium	<20	<20	20
Zinc	63	61	20

SOUTHWEST RESEARCH INSTITUTE

SAMPLE ANALYSIS DATA SHEET
FOR MINOR METALS

Sample ID
20K

Lab Name: Southwest Research Institute

Lab Code: SWRI

Matrix: Solid

Lab System ID: 56772

Client: Division 20

Date Received: 07/13/95

Date Analyzed: 08/07/95

Project No.: 20-5704-152

Analysis	Sample Result (ug/g)	Detection Limit (ug/g)
Antimony	<10	10
Arsenic	<25	25
Barium	315	4
Beryllium	3	2
Boron	<20	20
Cadmium	<4	4
Chromium	9	4
Cobalt	<10	10
Copper	<4	4
Lead	21	10
Lithium	221	4
Manganese	594	4
Molybdenum	<4	4
Nickel	<12	12
Phosphorus	<80	80
Selenium	<10	10
Silver	<10	10
Sodium	629	25
Strontium	299	10
Thallium	<10	10
Tin	<20	20
Vanadium	61	20
Zinc	59	20

SOUTHWEST RESEARCH INSTITUTE

SAMPLE ANALYSIS DATA SHEET
FOR MINOR METALS

Sample ID
20L

Lab Name: Southwest Research Institute

Client: Division 20

Lab Code: SWRI

Date Received: 07/13/95

Matrix: Solid

Date Analyzed: 08/07/95

Lab System ID: 56773

Project No.: 20-5704-152

Analysis	Sample Result (ug/g)	Detection Limit (ug/g)
Antimony	<10	10
Arsenic	<25	25
Barium	52	4
Beryllium	3	2
Boron	<20	20
Cadmium	<4	4
Calcium	261	20
Chromium	8	4
Cobalt	<10	10
Copper	<4	4
Lead	20	10
Lithium	230	4
Manganese	258	4
Molybdenum	<4	4
Nickel	<12	12
Phosphorus	<80	80
Potassium	560	40
Selenium	<10	10
Silver	<10	10
Strontium	<10	10
Thallium	<10	10
Tin	<20	20
Vanadium	<20	20
Zinc	58	20

SOUTHWEST RESEARCH INSTITUTE

SAMPLE ANALYSIS DATA SHEET
FOR MINOR METALS

Sample ID
20M

Lab Name: Southwest Research Institute

Client: Division 20

Lab Code: SWRI

Date Received: 07/13/95

Matrix: Solid

Date Analyzed: 08/07/95

Lab System ID: 56774

Project No.: 20-5704-152

Analysis	Sample Result (ug/g)	Detection Limit (ug/g)
Antimony	<10	10
Arsenic	<25	25
Barium	613	4
Beryllium	<2	2
Boron	<20	20
Cadmium	<4	4
Chromium	74	4
Cobalt	16	10
Copper	29	4
Lead	28	10
Lithium	48	4
Manganese	419	4
Molybdenum	<4	4
Nickel	29	12
Selenium	<10	10
Silver	<10	10
Strontium	174	10
Thallium	<10	10
Tin	<20	20
Vanadium	142	20
Zinc	119	20

SOUTHWEST RESEARCH INSTITUTE

SAMPLE ANALYSIS DATA SHEET
FOR MINOR METALS

Sample ID
20N

Lab Name: Southwest Research Institute

Client: Division 20

Lab Code: SWRI

Date Received: 07/13/95

Matrix: Solid

Date Analyzed: 08/07/95

Lab System ID: 56775

Project No.: 20-5704-152

Analysis	Sample Result (ug/g)	Detection Limit (ug/g)
Antimony	<10	10
Arsenic	<25	25
Barium	582	4
Beryllium	<2	2
Boron	<20	20
Cadmium	<4	4
Chromium	66	4
Cobalt	19	10
Copper	28	4
Lead	23	10
Lithium	46	4
Manganese	388	4
Molybdenum	<4	4
Nickel	28	12
Selenium	<10	10
Silver	<10	10
Strontium	165	10
Thallium	<10	10
Tin	<20	20
Vanadium	130	20
Zinc	108	20

========== Southwest Research Institute ==========

Jade: Peak Listing Thu Sep 21 1995 @10:36am

File: URAN6B.MDI> URAN6B * XRD

Scan Parameters:	Search Parameters:
Radiation = CU_1.54059	Filter length(pts) = 25
Scan Range = 2- 70	Noise level(sigmas) = 3.0
Step Size = .02	Intensity cutoff(%) = 1.0-100
Count Time = 2 sec.	2-Theta Zero (degs) = 0

	Peak-Position		Centroid-Position		Peak & Area are without Bkgrd					
#	2Theta	d	2Theta	d	Bkgrd	Peak	I%	Area	I%	FWHM*
1:	11.259	7.8526	11.226	7.8754	31	2037	100.0	412	100.0	0.182
2:	13.423	6.5912	13.407	6.5989	29	1667	81.8	322	78.2	0.174
3:	16.361	5.4136	16.356	5.4152	27	858	42.1	163	39.6	0.171
4:	18.500	4.7921	18.512	4.7891	26	765	37.6	192	46.6	0.226
5:	20.723	4.2828	20.727	4.2820	27	176	8.6	35	8.5	0.179
6:	22.580	3.9345	22.569	3.9365	24	1376	67.6	271	65.8	0.177
7:	24.796	3.5878	24.773	3.5910	17	506	24.8	94	22.8	0.167
8:	25.478	3.4933	25.489	3.4917	15	180	8.8	39	9.5	0.195
9:	26.998	3.2999	26.994	3.3004	16	156	7.7	22	5.3	0.127
10:	27.918	3.1932	27.900	3.1953	18	408	20.0	80	19.4	0.176
11:	28.860	3.0911	28.859	3.0913	20	53	2.6	6	1.5	0.102
12:	29.902	2.9858	29.911	2.9848	25	1965	96.5	357	86.7	0.164
13:	30.721	2.9080	30.721	2.9080	23	989	48.6	219	53.2	0.199
14:	31.683	2.8219	31.685	2.8217	28	51	2.5	9	2.2	0.159
15:	32.100	2.7861	32.100	2.7861	28	68	3.3	9	2.2	0.119
16:	33.281	2.6899	33.282	2.6898	25	734	36.0	154	37.4	0.189
17:	34.138	2.6243	34.157	2.6229	25	234	11.5	55	13.3	0.212
18:	35.098	2.5547	35.098	2.5547	20	100	4.9	16	3.9	0.144
19:	35.537	2.5242	35.530	2.5246	17	210	10.3	44	10.7	0.189
20:	37.438	2.4003	37.441	2.4000	10	56	2.7	12	2.9	0.193
21:	37.752	2.3810	37.755	2.3808	10	30	1.5	5	1.2	0.150
22:	39.921	2.2565	39.935	2.2557	12	224	11.0	43	10.4	0.173
23:	41.041	2.1975	41.033	2.1979	16	562	27.6	142	34.5	0.227
24:	43.138	2.0953	43.122	2.0961	20	561	27.5	145	35.2	0.233
25:	44.061	2.0536	44.075	2.0529	23	336	16.5	80	19.4	0.214
26:	44.459	2.0361	44.460	2.0361	24	73	3.6	13	3.2	0.160
27:	46.037	1.9699	46.040	1.9698	23	288	14.1	52	12.6	0.162
28:	46.377	1.9563	46.368	1.9566	20	250	12.3	70	17.0	0.252
29:	47.679	1.9058	47.681	1.9058	15	137	6.7	31	7.5	0.204
30:	48.239	1.8850	48.250	1.8846	17	123	6.0	41	10.0	0.300
31:	48.760	1.8661	48.760	1.8661	19	260	12.8	78	18.9	0.270
32:	49.980	1.8234	49.980	1.8234	23	121	5.9	16	3.9	0.119
33:	50.494	1.8060	50.485	1.8063	26	47	2.3	5	1.2	0.096
34:	51.721	1.7660	51.716	1.7662	32	180	8.8	47	11.4	0.235
35:	52.236	1.7498	52.238	1.7497	26	108	5.3	21	5.1	0.175
36:	52.515	1.7411	52.511	1.7413	25	122	6.0	8	1.9	0.059
37:	55.258	1.6610	55.262	1.6609	20	244	12.0	41	10.0	0.151
38:	55.574	1.6524	55.574	1.6524	21	242	11.9	44	10.7	0.164
39:	56.897	1.6170	56.895	1.6171	24	41	2.0	7	1.7	0.154
40:	57.560	1.6000	57.560	1.6000	21	111	5.4	15	3.6	0.122
41:	57.960	1.5899	57.962	1.5898	19	77	3.8	18	4.4	0.210
42:	58.497	1.5765	58.512	1.5762	19	189	9.3	55	13.3	0.262
43:	59.077	1.5624	59.081	1.5624	36	63	3.1	11	2.7	0.157

#	2Theta	d	2Theta	d	Bkgrd	Peak	I%	Area	I%	FWHM*
44:	60.161	1.5369	60.163	1.5368	15	95	4.7	23	5.6	0.218
45:	60.249	1.5348	60.249	1.5348	14	84	4.1	5	1.2	0.054
[illegible]:	61.701	1.5021	61.700	1.5022	14	101	5.0	19	4.6	0.169
47:	62.038	1.4948	62.052	1.4945	15	176	8.6	40	9.7	0.205
48:	62.340	1.4883	62.340	1.4883	16	89	4.4	29	7.0	0.293
49:	63.864	1.4564	63.854	1.4566	20	87	4.3	37	9.0	0.383
50:	64.840	1.4368	64.837	1.4369	15	104	5.1	32	7.8	0.277
51:	68.417	1.3701	68.414	1.3702	25	45	2.2	7	1.7	0.140

* Intensity values are based on total raw counts.

========== Southwest Research Institute ==========

Jade: Peak Listing — Thu Sep 21 1995 @10:39am

File: SODD5B.MDI> SODD5B * XRD

Scan Parameters:	Search Parameters:
Radiation = CU_1.54059	Filter length(pts) = 25
Scan Range = 2- 70	Noise level(sigmas) = 3.0
Step Size = .02	Intensity cutoff(%) = 1.0-100
Count Time = 2 sec.	2-Theta Zero (degs) = 0

	Peak-Position		Centroid-Position		Peak & Area are without Bkgrd					
#	2Theta	d	2Theta	d	Bkgrd	Peak	I%	Area	I%	FWHM*
1:	14.262	6.2050	14.231	6.2185	19	1806	76.4	379	72.2	0.189
2:	18.600	4.7665	18.584	4.7707	15	481	20.3	106	20.2	0.198
3:	19.141	4.6330	19.141	4.6332	14	151	6.4	23	4.4	0.137
4:	19.680	4.5074	19.651	4.5140	12	1722	72.8	333	63.4	0.174
5:	23.638	3.7608	23.617	3.7641	10	285	12.1	57	10.9	0.180
6:	26.880	3.3142	26.849	3.3179	11	2365	100.0	525	100.0	0.200
7:	27.558	3.2341	27.548	3.2353	12	453	19.2	82	15.6	0.163
8:	30.038	2.9725	30.032	2.9731	8	460	19.5	92	17.5	0.180
9:	32.059	2.7896	32.044	2.7909	11	276	11.7	62	11.8	0.202
10:	33.100	2.7042	33.114	2.7031	9	712	30.1	150	28.6	0.190
11:	33.861	2.6452	33.870	2.6445	10	100	4.2	18	3.4	0.162
12:	35.818	2.5050	35.824	2.5046	11	55	2.3	9	1.7	0.147
13:	36.244	2.4765	36.248	2.4763	7	445	18.8	77	14.7	0.156
14:	36.599	2.4533	36.596	2.4535	7	259	11.0	64	12.2	0.222
15:	37.559	2.3928	37.570	2.3921	6	40	1.7	9	1.7	0.203
16:	38.776	2.3204	38.789	2.3197	6	132	5.6	25	4.8	0.170
17:	40.138	2.2448	40.124	2.2455	9	236	10.0	52	9.9	0.198
18:	41.000	2.1996	41.012	2.1989	9	177	7.5	37	7.0	0.188
19:	41.580	2.1702	41.591	2.1697	10	56	2.4	15	2.9	0.241
20:	43.341	2.0860	43.350	2.0856	12	458	19.4	108	20.6	0.212
21:	43.819	2.0644	43.820	2.0643	11	150	6.3	39	7.4	0.234
22:	44.440	2.0369	44.431	2.0373	11	169	7.1	39	7.4	0.208
23:	45.998	1.9715	46.000	1.9714	10	233	9.9	41	7.8	0.158
24:	47.801	1.9013	47.799	1.9013	14	232	9.8	72	13.7	0.279
25:	48.258	1.8843	48.248	1.8847	11	75	3.2	24	4.6	0.288
26:	49.060	1.8554	49.071	1.8550	9	418	17.7	106	20.2	0.228
27:	51.083	1.7866	51.089	1.7864	8	33	1.4	7	1.3	0.191
28:	51.757	1.7649	51.769	1.7645	9	103	4.4	29	5.5	0.253
29:	52.900	1.7294	52.903	1.7293	12	67	2.8	13	2.5	0.175
30:	53.881	1.7002	53.883	1.7001	17	174	7.4	48	9.1	0.248
31:	54.820	1.6733	54.820	1.6733	13	150	6.3	37	7.0	0.222
32:	55.196	1.6628	55.192	1.6629	13	206	8.7	71	13.5	0.310
33:	55.920	1.6429	55.920	1.6429	16	222	9.4	48	9.1	0.195
34:	57.620	1.5984	57.624	1.5983	13	100	4.2	26	5.0	0.234
35:	58.257	1.5825	58.260	1.5824	13	98	4.1	25	4.8	0.230
36:	58.936	1.5658	58.938	1.5658	12	41	1.7	12	2.3	0.263
37:	59.639	1.5491	59.639	1.5491	13	45	1.9	8	1.5	0.160
38:	60.818	1.5218	60.833	1.5215	10	62	2.6	18	3.4	0.261
39:	61.236	1.5124	61.233	1.5125	10	96	4.1	40	7.6	0.375
40:	63.180	1.4705	63.187	1.4703	10	71	3.0	16	3.0	0.203
41:	66.458	1.4057	66.457	1.4057	10	123	5.2	23	4.4	0.168
42:	66.500	1.4049	66.500	1.4049	10	95	4.0	11	2.1	0.104
43:	69.381	1.3534	69.381	1.3534	37	62	2.6	11	2.1	0.160

#	2Theta	d	2Theta	d	Bkgrd	Peak	I%	Area	I%	FWHM*

* Intensity values are based on total raw counts.

URANOPHANE SYNTHESIS

WRITTEN BY: J.D. Prikryl
REVISION NO.: 2

DATE WRITTEN: March 7, 1995
DATE REVISED: Sept 8, 1995

OBJECTIVE: to synthesize uranophane [$Ca(UO_2)_2(SiO_3OH)_2.5H_2O$] for use in thermodynamic experiments of uranyl silicate minerals for the near-field geochemistry project.

EQUIPMENT:
Parr stainless steel reaction vessels (Model 4913EB; 2000 ml capacity)
Teflon liners for reaction vessels
Parr Model 4841 or 4843 temperature controllers
Type J themocouples (teflon coated)
ORION ph/mV/ISE/^{o}C meter
Combination ph electrode
Automatic termperature compensator probe
Analytical balance (Mettler PM 4600)
Welsh vacuum pump (Model 8910)
Hot plate (Thermolyne Type 13100)
Spectra mesh teflon (70 micron openings)
Teflon beading

SUPPLIES:
pH buffers (pH= 1,2,4)
ultrapure water
glassware and platicware as needed
Fittings, valves, and tubing as necessary

REAGENTS:
Uranyl acetate dihydrate [$UO_2(CH_3COO_2.2H_2O$; MW=424.15 (analysis no. 337419/1 1094)
Silicic acid [$SiO_2.nH_2O$]; MW depends on H_2O content; assume no H_2O; MW = 60 (lot 951303)
Calcium acetate monohydrate [$Ca(CH_3COO)_2.H_2O$; MW=176.19 (lot 944231)
9 M HCl - diluted from lot 945500

PROCEDURE:

The procedure for uranophane synthesis is based on Cesbron et al., 1993. Reagents will be mixed in the stoichiometric ratio Ca:U:Si = 2:1:1. Although Cesbron et al. do not give information on the amount of solid and H_2O used, they state that good crystallinity is obtained if pH is less than 5.

a) Place 17.5 g Ca-acetate and 21 g U-acetate in a 2000 ml teflon liner.

b) Place 3 g silicic acid (coarse fraction separated by density settling) in spectra mesh. Wrap mesh and secure with teflon beading. Place mesh in teflon liner.

c) Transfer approximately 1000 ml of ultrapure H_2O to a 2000 ml erlenmeyer flask and lower pH of the fluid to 1.0 by dropwise addition of 9M HCl.

d) Transfer approximately 650 g of the degassed H_2O to the teflon liner and place in pressure vessel.

e) Raise and set the temperature of the solution in the reaction vessel to 150C using the temperature controller.

f) Degas the pressure vessel once it reaches >140C by opening the air intake valve attached to the pressure gauge assembly.

g) Close intake valve after degassing and allow reagents to react for about 10 days.

SODDYITE SYNTHESIS

WRITTEN BY: J.D. Prikryl
REVISION NO.: 1

DATE WRITTEN: July 3, 1995
DATE REVISED: Sept 7, 1995

OBJECTIVE: to synthesize soddyite [$(UO_2)_2SiO_4.2H_2O$] for use in thermodynamic experiments of uranyl silicate minerals for the near-field geochemistry project.

EQUIPMENT:
Parr stainless steel reaction vessels (Model 4913EB; 2000 ml capacity)
Teflon liners for reaction vessels
Parr Model 4841 or 4843 temperature controllers
Type J themocouples (teflon coated)
ORION ph/mV/ISE/^{o}C meter
Combination ph electrode
Automatic termperature compensator probe
Analytical balance (Mettler PM 4600)
Hot plate (Thermolyne Type 13100)
Spectra Mesh teflon (70 micron openings)
Teflon beading
Teflon centrifuge tubes (50 ml)

SUPPLIES:
pH buffers (pH= 1,2,4)
ultrapure water
glassware and platicware as needed
Fittings, valves, and tubing as necessary

REAGENTS:
Uranyl acetate dihydrate [$UO_2(CH_3COO_2.2H_2O)$]; MW=424.15 (lot 944231)
Silicic acid [$SiO_2.nH_2O$]; MW depends on H_2O content; assume no H_2O; MW = 60 (lot 951303)
9 M HCl - diluted from lot 945500

PROCEDURE:

Reagents for soddyite synthesis will be mixed in the stoichiometric ratio U:Si = 1:2.

a) Place 21 g U-acetate in a 2000 ml teflon liner.

b) Place 6 g silicic acid (coarse fraction separated by density settling) in a 50 ml teflon centrifuge tube. Cover tube opening with spectra mesh and secure with teflon beading. Place tube in the teflon liner.

c) Transfer approximately 650 g of ultrapure H_2O to the teflon liner and place in the pressure vessel. Make sure H_2O enters centrifuge tube and then seal vessel.

d) Raise and set the temperature of the solution in the reaction vessel to 150C using the temperature controller.

e) Degas the pressure vessel once it reaches about >140C by opening the air intake value attached to the pressure gauge assembly.

f) Close intake value after degassing and allow the reagents to react for about 10 days.

URANOPHANE SYNTHESIS

WRITTEN BY: J.D. Prikryl
REVISION NO.: 1

DATE WRITTEN: March 7, 1995
DATE REVISED: Aug 9, 1995

OBJECTIVE: to synthesize uranophane [$Ca(UO_2)_2(SiO_3OH)_2.5H_2O$] for use in thermodynamic experiments of uranyl silicate minerals for the near-field geochemistry project.

EQUIPMENT:
Parr stainless steel reaction vessels (Model 4913EB; 2000 ml capacity)
Teflon liners for reaction vessels
Parr Model 4841 or 4843 temperature controllers
Type J themocouples (teflon coated)
ORION ph/mV/ISE/^{o}C meter
Combination ph electrode
Automatic termperature compensator probe
Analytical balance (Mettler PM 4600)
Welsh vacuum pump (Model 8910)
Hot plate (Thermolyne Type 13100)

SUPPLIES:
pH buffers (pH= 1,2,4)
ultrapure water
glassware and platicware as needed
1000 ml erlenmeyer flasks with stoppers
Fittings, valves, and tubing as necessary

REAGENTS:
Uranyl acetate dihydrate [$UO_2(CH_3COO_2.2H_2O$; MW=424.15 (lot 944231)
Silicic acid [$SiO_2.nH_2O$]; MW depends on H_2O content; assume $4H_2O$ - MW = 132 (lot 951303)
Calcium acetate monohydrate [$Ca(CH_3COO)_2.H_2O$; MW=176.19 (lot 319617/1 194)
9 M HCl - diluted from lot 945500

PROCEDURE:

The procedure for uranophane synthesis is based on Cesbron et al., 1993. Reagents will be mixed in the stoichiometric ratio Ca:U:Si = 2:1:1. Although Cesbron et al. do not give information on the amount of solid and H_2O used, they state that good crystallinity is obtained if pH is less than 5.

a) Place 17.5 g Ca-acetate, 21 g U-acetate, and 6.5 g silicic acid in a 2000 ml teflon liner and place liner in reaction vessel.

b) Cap and seal vessel and evacuate using a vacuum pump to remove $CO_2(g)$.

c) Transfer approximately 1000 ml of ultrapure H_2O to a 2000 ml erlenmeyer flask and lower pH of the fluid to 1.0 by dropwise addition of 9M HCl.

d) Degas the H_2O by boiling on a hotplate. After degassing cap erlenmeyer flask with a rubber stopper so that air cannot enter the flask.

e) After cooling record weight of the erlenmeyer flask with the degassed H2O.

f) Transfer approximately 650 g of the degassed H2O into the vessel by pulling in by vacuum. After the transfer, record weight of the erlenmeyer flask with remaining degassed H2O to determine actual weight of H2O introduced.

g) Raise and set the temperature of the solution in the reaction vessel to 150C using the temperature controller and allow the reaction to proceed for one week or longer.

========== Southwest Research Institute ==========

Jade: Peak Listing Tue Jul 18 1995 @2:08pm

File: SODD1.MDI> 7/28/95 - SODD1 * XRD

Scan Parameters:	Search Parameters:
Radiation = CU_1.54059	Filter length(pts) = 25
Scan Range = 2- 70	Noise level(sigmas) = 3.0
Step Size = .02	Intensity cutoff(%) = 1.0-100
Count Time = 2 sec.	2-Theta Zero (degs) = 0

	Peak-Position		Centroid-Position		Peak & Area are without Bkgrd					
#	2Theta	d	2Theta	d	Bkgrd	Peak	I%	Area	I%	FWHM*
1:	13.040	6.7839	13.047	6.7803	60	1062	99.8	406	100.0	0.344
2:	13.420	6.5927	13.414	6.5954	46	470	44.2	163	40.1	0.312
3:	14.840	5.9647	14.830	5.9687	61	493	46.3	140	34.5	0.256
4:	16.460	5.3811	16.462	5.3806	34	27	2.5	5	1.2	0.167
5:	18.520	4.7869	18.514	4.7885	32	474	44.5	127	31.3	0.241
6:	19.602	4.5252	19.593	4.5272	35	52	4.9	13	3.2	0.225
7:	21.004	4.2262	21.003	4.2263	32	63	5.9	20	4.9	0.286
8:	22.700	3.9141	22.684	3.9167	37	443	41.6	132	32.5	0.268
9:	23.780	3.7387	23.785	3.7379	35	147	13.8	49	12.1	0.300
10:	24.679	3.6045	24.674	3.6052	37	86	8.1	20	4.9	0.209
11:	25.781	3.4529	25.788	3.4520	35	674	63.3	179	44.1	0.239
12:	26.380	3.3758	26.375	3.3765	35	313	29.4	121	29.8	0.348
13:	27.019	3.2974	27.019	3.2975	34	82	7.7	20	4.9	0.220
14:	29.001	3.0765	28.992	3.0774	50	378	35.5	119	29.3	0.283
15:	29.840	2.9918	29.839	2.9919	36	333	31.3	115	28.3	0.311
16:	30.482	2.9302	30.496	2.9290	42	1064	100.0	315	77.6	0.266
17:	32.023	2.7926	32.034	2.7917	36	71	6.7	21	5.2	0.266
18:	32.922	2.7184	32.916	2.7189	35	57	5.4	14	3.4	0.221
19:	34.819	2.5745	34.829	2.5738	30	111	10.4	32	7.9	0.259
20:	35.400	2.5336	35.408	2.5331	30	51	4.8	18	4.4	0.318
21:	35.859	2.5022	35.866	2.5018	27	148	13.9	55	13.5	0.334
22:	39.879	2.2588	39.880	2.2587	26	64	6.0	12	3.0	0.169
23:	40.285	2.2369	40.285	2.2369	28	72	6.8	4	1.0	0.050
24:	40.581	2.2213	40.579	2.2214	30	85	8.0	25	6.2	0.265
25:	41.141	2.1923	41.160	2.1914	34	147	13.8	43	10.6	0.263
26:	41.480	2.1752	41.480	2.1752	36	176	16.5	30	7.4	0.153
27:	42.722	2.1148	42.722	2.1148	45	70	6.6	18	4.4	0.231
28:	42.840	2.1093	42.840	2.1092	46	70	6.6	18	4.4	0.231
29:	43.659	2.0715	43.658	2.0716	43	119	11.2	29	7.1	0.219
30:	44.040	2.0545	44.043	2.0544	48	51	4.8	7	1.7	0.124
31:	45.479	1.9928	45.480	1.9928	53	70	6.6	13	3.2	0.167
32:	46.119	1.9666	46.120	1.9666	49	71	6.7	16	3.9	0.203
33:	47.363	1.9178	47.363	1.9178	52	56	5.3	4	1.0	0.064
34:	48.461	1.8769	48.485	1.8760	43	286	26.9	93	22.9	0.293
35:	49.200	1.8504	49.201	1.8504	38	125	11.7	29	7.1	0.209
36:	49.879	1.8268	49.878	1.8269	36	66	6.2	26	6.4	0.355
37:	49.998	1.8228	49.999	1.8227	40	49	4.6	8	2.0	0.147
38:	52.282	1.7484	52.288	1.7482	34	77	7.2	13	3.2	0.152
39:	52.979	1.7270	52.982	1.7269	36	145	13.6	39	9.6	0.242
40:	54.780	1.6744	54.780	1.6744	43	93	8.7	27	6.7	0.261
41:	54.858	1.6722	54.859	1.6722	43	117	11.0	22	5.4	0.169
42:	55.041	1.6671	55.041	1.6671	44	135	12.7	46	11.3	0.307
43:	55.096	1.6656	55.082	1.6659	44	115	10.8	13	3.2	0.102

#	2Theta	d	2Theta	d	Bkgrd	Peak	I%	Area	I%	FWHM*
44:	55.580	1.6522	55.577	1.6523	42	85	8.0	30	7.4	0.318
45:	56.860	1.6180	56.861	1.6180	45	52	4.9	7	1.7	0.121
46:	56.999	1.6144	56.997	1.6144	44	47	4.4	4	1.0	0.077
47:	58.380	1.5794	58.383	1.5793	33	36	3.4	7	1.7	0.175
48:	58.479	1.5770	58.477	1.5770	33	42	3.9	8	2.0	0.171
49:	59.815	1.5449	59.822	1.5447	29	38	3.6	14	3.4	0.332
50:	59.979	1.5411	59.979	1.5411	29	55	5.2	5	1.2	0.082
51:	61.841	1.4991	61.840	1.4991	28	89	8.4	18	4.4	0.182
52:	62.260	1.4900	62.260	1.4900	28	70	6.6	20	4.9	0.257
53:	63.320	1.4676	63.320	1.4676	30	61	5.7	5	1.2	0.074
54:	63.396	1.4660	63.398	1.4660	30	56	5.3	7	1.7	0.112

* Intensity values are based on total raw counts.

SODDYITE SYNTHESIS

WRITTEN BY: J.D. Prikryl
REVISION NO.: 0

DATE WRITTEN: July 3, 1995
DATE REVISED:

OBJECTIVE: to synthesize soddyite [$(UO_2)_2SiO_4.2H_2O$] for use in thermodynamic experiments of uranyl silicate minerals for the near-field geochemistry project.

EQUIPMENT:
Parr stainless steel reaction vessels (Model 4913EB; 2000 ml capacity)
Teflon liners for reaction vessels
Parr Model 4841 or 4843 temperature controllers
Type J themocouples (teflon coated)
ORION ph/mV/ISE/^{o}C meter
Combination ph electrode
Automatic termperature compensator probe
Analytical balance (Mettler PM 4600)
Welsh vacuum pump (Model 8910)
Hot plate (Thermolyne Type 13100)

SUPPLIES:
pH buffers (pH= 1,2,4)
ultrapure water
glassware and platicware as needed
1000 ml erlenmeyer flasks with stoppers
Fittings, valves, and tubing as necessary

REAGENTS:
Uranyl acetate dihydrate [$UO_2(CH_3COO_2.2H_2O)$]; MW=424.15 (lot 944231)
Sodium metasilicate nonahydrate [$Na_2SiO_3.9H_2O$]; MW=284.20 (lot 942853A)
Silicic acid [$SiO_2.nH_2O$]; MW depends on H_2O content; assume $4H_2O$ - MW = 132 (lot 951303)
9 M HCl - diluted from lot 945500

PROCEDURE:

The procedure for uranophane synthesis is based on Nguyen et al., 1992. Reagents will be mixed in the stoichiometric ratio U:Si = 1:2.

a) Two batches will be synthesized but reagent for Si will be different to see if Na can be removed from system.
(1) Place 42 g U-acetate, and 56 g Na-metasilicate in a 2000 ml teflon liner and place liner in reaction vessel.
(2) Place 42 g U-acetate, and 26 g silicic acid in a 2000 ml teflon liner and place liner in reaction vessel.

b) Cap and seal vessel and evacuate using a vacuum pump to remove $CO_2(g)$.

c) Transfer approximately 2000 ml of ultrapure H_2O to a 2000 ml erlenmeyer flask and lower pH of the fluid to 1.0 by dropwise addition of 9M HCl.

d) Degas the H_2O at a pH of 1.0 by boiling on a hotplate. After degassing cap erlenmeyer flask with a rubber stopper so that air cannot enter the flask.

e) After cooling record weight of the erlenmeyer flask with the degassed H_2O.

f) Transfer approximately 1300 g of the degassed H_2O into the vessel by pulling in by vacuum. After the transfer, record weight of the erlenmeyer flask with remaining degassed H_2O to determine actual weight of H_2O introduced.

g) Raise and set the temperature of the solution in the reaction vessel to 150C using the temperature controller and allow the reaction to proceed for one week or longer.

========== Southwest Research Institute ==========

Jade: Peak Listing Sat Jul 08 1995 @2:48pm

File: URAN3.MDI> 7/12/95 - URAN3*XRD

Scan Parameters:	Search Parameters:
Radiation = CU_1.54059	Filter length(pts) = 25
Scan Range = 2- 70	Noise level(sigmas) = 3.0
Step Size = .02	Intensity cutoff(%) = 1.0-100
Count Time = 2 sec.	2-Theta Zero (degs) = 0

	Peak-Position		Centroid-Position		Peak & Area are without Bkgrd					
#	2Theta	d	2Theta	d	Bkgrd	Peak	I%	Area	I%	FWHM*
1:	11.320	7.8106	11.293	7.8287	30	1861	100.0	484	100.0	0.234
2:	13.483	6.5621	13.472	6.5670	29	448	24.1	107	22.1	0.215
3:	16.439	5.3881	16.418	5.3948	26	425	22.8	122	25.2	0.258
4:	18.560	4.7769	18.561	4.7766	26	780	41.9	199	41.1	0.230
5:	20.783	4.2706	20.792	4.2688	24	183	9.8	43	8.9	0.211
6:	22.641	3.9241	22.634	3.9253	21	1178	63.3	303	62.6	0.231
7:	24.839	3.5816	24.827	3.5834	23	274	14.7	76	15.7	0.250
8:	25.539	3.4850	25.543	3.4845	27	617	33.2	117	24.2	0.171
9:	26.141	3.4061	26.144	3.4057	31	49	2.6	7	1.4	0.129
10:	27.944	3.1903	27.962	3.1883	31	679	36.5	167	34.5	0.221
11:	28.942	3.0826	28.944	3.0824	32	102	5.5	15	3.1	0.132
12:	29.979	2.9783	29.974	2.9787	39	822	44.2	191	39.5	0.209
13:	30.780	2.9025	30.770	2.9035	37	519	27.9	165	34.1	0.286
14:	33.342	2.6851	33.350	2.6845	34	283	15.2	78	16.1	0.248
15:	34.240	2.6167	34.240	2.6167	31	218	11.7	30	6.2	0.124
16:	35.085	2.5556	35.103	2.5544	26	43	2.3	11	2.3	0.230
17:	35.158	2.5505	35.157	2.5505	25	61	3.3	15	3.1	0.221
18:	35.562	2.5224	35.569	2.5220	22	124	6.7	41	8.5	0.298
19:	35.920	2.4981	35.920	2.4981	20	54	2.9	10	2.1	0.167
20:	37.460	2.3988	37.466	2.3985	13	41	2.2	5	1.0	0.110
21:	40.019	2.2512	40.019	2.2512	17	102	5.5	24	5.0	0.212
22:	41.079	2.1955	41.079	2.1955	21	249	13.4	93	19.2	0.336
23:	43.140	2.0953	43.155	2.0946	27	303	16.3	100	20.7	0.297
24:	44.141	2.0500	44.143	2.0500	30	91	4.9	28	5.8	0.277
25:	46.081	1.9682	46.081	1.9681	27	172	9.2	34	7.0	0.178
26:	46.220	1.9625	46.220	1.9626	27	144	7.7	59	12.2	0.369
27:	46.359	1.9570	46.347	1.9575	27	178	9.6	70	14.5	0.354
28:	47.720	1.9043	47.732	1.9039	28	177	9.5	44	9.1	0.224
29:	48.321	1.8820	48.319	1.8821	30	148	8.0	37	7.6	0.225
30:	48.878	1.8619	48.879	1.8618	32	170	9.1	41	8.5	0.217
31:	50.061	1.8206	50.062	1.8206	34	66	3.5	14	2.9	0.191
32:	50.150	1.8176	50.147	1.8177	34	59	3.2	15	3.1	0.229
33:	51.759	1.7648	51.768	1.7645	41	103	5.5	33	6.8	0.288
34:	52.319	1.7472	52.320	1.7472	36	108	5.8	35	7.2	0.292
35:	52.400	1.7447	52.399	1.7447	36	117	6.3	51	10.5	0.392
36:	52.558	1.7398	52.547	1.7402	35	101	5.4	21	4.3	0.187
37:	53.643	1.7072	53.639	1.7073	45	64	3.4	12	2.5	0.169
38:	55.243	1.6615	55.242	1.6615	34	60	3.2	10	2.1	0.150
39:	55.600	1.6516	55.600	1.6516	33	64	3.4	10	2.1	0.141
40:	57.599	1.5990	57.602	1.5989	29	77	4.1	26	5.4	0.304
41:	58.582	1.5745	58.581	1.5745	28	89	4.8	26	5.4	0.263
42:	59.140	1.5609	59.141	1.5609	31	35	1.9	9	1.9	0.231
43:	60.184	1.5363	60.194	1.5361	24	66	3.5	16	3.3	0.218

#	2Theta	d	2Theta	d	Bkgrd	Peak	I%	Area	I%	FWHM*
44:	60.319	1.5332	60.319	1.5332	23	45	2.4	11	2.3	0.220
45:	61.763	1.5008	61.774	1.5005	23	46	2.5	15	3.1	0.293
46:	62.078	1.4939	62.081	1.4938	24	69	3.7	30	6.2	0.391
47:	62.280	1.4896	62.279	1.4896	25	68	3.7	20	4.1	0.265
48:	63.843	1.4568	63.848	1.4567	26	61	3.3	15	3.1	0.221
49:	63.921	1.4552	63.923	1.4552	26	70	3.8	6	1.2	0.077
50:	64.822	1.4372	64.828	1.4370	23	93	5.0	37	7.6	0.358
51:	68.520	1.3683	68.519	1.3683	32	35	1.9	7	1.4	0.180

* Intensity values are based on total raw counts.

========== Southwest Research Institute ==========

Jade: Peak Listing — Thu Nov 30 1995 @4:25pm

File: SODD8.MDI> SODD8 * XRD

Scan Parameters:	Search Parameters:
Radiation = CU_1.54059	Filter length(pts) = 25
Scan Range = 2- 70	Noise level(sigmas) = 3.0
Step Size = .02	Intensity cutoff(%) = 1.0-100
Count Time = 2 sec.	2-Theta Zero (degs) = 0

	Peak-Position		Centroid-Position		Peak & Area are without Bkgrd					
#	2Theta	d	2Theta	d	Bkgrd	Peak	I%	Area	I%	FWHM*
1:	14.257	6.2072	14.224	6.2217	27	3049	96.2	559	96.0	0.165
2:	18.560	4.7769	18.546	4.7804	23	790	24.9	184	31.6	0.210
3:	19.184	4.6229	19.190	4.6214	22	368	11.6	79	13.6	0.193
4:	19.662	4.5115	19.649	4.5143	22	3169	100.0	582	100.0	0.165
5:	23.658	3.7577	23.640	3.7606	15	473	14.9	93	16.0	0.177
6:	26.861	3.3165	26.851	3.3176	14	2783	87.8	537	92.3	0.174
7:	27.558	3.2341	27.547	3.2355	17	818	25.8	145	24.9	0.160
8:	29.961	2.9800	29.971	2.9790	20	628	19.8	141	24.2	0.202
9:	31.919	2.8015	31.932	2.8004	18	303	9.6	85	14.6	0.252
10:	33.063	2.7071	33.086	2.7053	15	1305	41.2	285	49.0	0.197
11:	33.883	2.6435	33.893	2.6427	15	155	4.9	29	5.0	0.168
12:	35.782	2.5075	35.785	2.5072	17	82	2.6	16	2.7	0.176
13:	36.278	2.4742	36.286	2.4737	13	724	22.8	162	27.8	0.201
14:	36.620	2.4519	36.601	2.4532	12	424	13.4	113	19.4	0.240
15:	37.459	2.3989	37.464	2.3986	16	51	1.6	11	1.9	0.194
16:	38.779	2.3202	38.791	2.3196	12	313	9.9	51	8.8	0.147
17:	40.040	2.2500	40.048	2.2496	18	267	8.4	71	12.2	0.239
18:	40.980	2.2006	40.987	2.2002	15	202	6.4	46	7.9	0.205
19:	41.599	2.1693	41.609	2.1687	18	89	2.8	19	3.3	0.192
20:	42.019	2.1485	42.013	2.1488	17	37	1.2	9	1.5	0.219
21:	43.321	2.0870	43.325	2.0868	17	523	16.5	143	24.6	0.246
22:	43.801	2.0652	43.802	2.0651	17	209	6.6	58	10.0	0.250
23:	44.281	2.0439	44.281	2.0439	17	190	6.0	69	11.9	0.327
24:	45.998	1.9715	46.015	1.9708	15	436	13.8	95	16.3	0.196
25:	47.760	1.9028	47.794	1.9015	24	331	10.4	119	20.4	0.324
26:	48.260	1.8842	48.259	1.8843	16	161	5.1	39	6.7	0.218
27:	49.039	1.8561	49.025	1.8566	18	585	18.5	174	29.9	0.268
28:	50.981	1.7899	50.991	1.7896	17	54	1.7	8	1.4	0.133
29:	51.719	1.7661	51.735	1.7656	16	223	7.0	55	9.5	0.222
30:	52.820	1.7318	52.815	1.7320	16	73	2.3	19	3.3	0.234
31:	53.780	1.7032	53.778	1.7032	22	179	5.6	67	11.5	0.337
32:	54.700	1.6766	54.701	1.6766	24	176	5.6	44	7.6	0.225
33:	55.139	1.6643	55.149	1.6641	15	260	8.2	78	13.4	0.270
34:	55.899	1.6435	55.899	1.6435	20	406	12.8	106	18.2	0.235
35:	57.461	1.6025	57.465	1.6024	17	117	3.7	35	6.0	0.269
36:	57.518	1.6010	57.522	1.6009	18	106	3.3	50	8.6	0.425
37:	58.300	1.5814	58.299	1.5814	20	143	4.5	37	6.4	0.233
38:	58.896	1.5668	58.895	1.5668	22	69	2.2	10	1.7	0.130
39:	59.615	1.5496	59.616	1.5496	23	84	2.7	15	2.6	0.161
40:	60.520	1.5286	60.525	1.5285	26	45	1.4	7	1.2	0.140
41:	61.240	1.5124	61.246	1.5122	22	160	5.0	49	8.4	0.276
42:	61.941	1.4969	61.940	1.4969	18	83	2.6	19	3.3	0.206
43:	63.240	1.4692	63.237	1.4693	15	87	2.7	23	4.0	0.238

#	2Theta	d	2Theta	d	Bkgrd	Peak	I%	Area	I%	FWHM*
44:	64.001	1.4536	64.003	1.4536	14	47	1.5	17	2.9	0.326
45:	66.475	1.4054	66.477	1.4053	16	158	5.0	51	8.8	0.291
46:	68.182	1.3743	68.193	1.3741	27	52	1.6	13	2.2	0.225
47:	69.220	1.3562	69.220	1.3562	50	96	3.0	23	4.0	0.216
48:	69.337	1.3542	69.338	1.3542	51	104	3.3	21	3.6	0.182

* Intensity values are based on total raw counts.

========== Southwest Research Institute ==========

Jade: Peak Listing — Thu Nov 30 1995 @4:27pm

File: SODD9.MDI> SODD9 * XRD

Scan Parameters:	Search Parameters:
Radiation = CU_1.54059	Filter length(pts) = 25
Scan Range = 2- 70	Noise level(sigmas) = 3.0
Step Size = .02	Intensity cutoff(%) = 1.0-100
Count Time = 2 sec.	2-Theta Zero (degs) = 0

	Peak-Position		Centroid-Position		Peak & Area are without Bkgrd					
#	2Theta	d	2Theta	d	Bkgrd	Peak	I%	Area	I%	FWHM*
1:	14.303	6.1875	14.273	6.2003	26	1850	68.5	470	81.2	0.229
2:	18.620	4.7616	18.603	4.7658	20	733	27.1	188	32.5	0.231
3:	19.245	4.6082	19.257	4.6055	18	297	11.0	75	13.0	0.227
4:	19.740	4.4938	19.712	4.5001	16	2702	100.0	546	94.3	0.182
5:	23.720	3.7481	23.695	3.7519	14	391	14.5	80	13.8	0.184
6:	26.922	3.3091	26.887	3.3133	14	2268	83.9	579	100.0	0.230
7:	27.620	3.2271	27.611	3.2281	15	701	25.9	132	22.8	0.169
8:	30.022	2.9741	30.036	2.9727	15	556	20.6	133	23.0	0.215
9:	31.980	2.7963	31.999	2.7947	16	275	10.2	78	13.5	0.255
10:	33.141	2.7009	33.159	2.6995	21	1143	42.3	255	44.0	0.201
11:	33.960	2.6377	33.968	2.6370	18	121	4.5	25	4.3	0.186
12:	35.822	2.5047	35.821	2.5048	14	60	2.2	9	1.6	0.135
13:	36.341	2.4702	36.353	2.4694	14	719	26.6	152	26.3	0.190
14:	36.679	2.4481	36.679	2.4481	13	387	14.3	87	15.0	0.202
15:	37.518	2.3953	37.528	2.3947	12	57	2.1	13	2.2	0.205
16:	38.841	2.3167	38.857	2.3158	13	250	9.3	40	6.9	0.144
17:	40.099	2.2469	40.109	2.2464	15	233	8.6	67	11.6	0.259
18:	41.042	2.1974	41.055	2.1967	11	170	6.3	38	6.6	0.201
19:	41.661	2.1662	41.675	2.1655	11	81	3.0	16	2.8	0.178
20:	42.160	2.1417	42.160	2.1417	10	29	1.1	7	1.2	0.217
21:	43.381	2.0842	43.389	2.0838	11	443	16.4	119	20.6	0.242
22:	43.881	2.0616	43.885	2.0614	14	174	6.4	16	2.8	0.083
23:	44.376	2.0397	44.364	2.0403	16	199	7.4	20	3.5	0.090
24:	46.060	1.9690	46.060	1.9690	11	403	14.9	66	11.4	0.147
25:	47.820	1.9006	47.857	1.8992	20	301	11.1	114	19.7	0.341
26:	48.340	1.8813	48.341	1.8813	14	114	4.2	36	6.2	0.284
27:	49.119	1.8533	49.120	1.8533	15	465	17.2	123	21.2	0.238
28:	51.099	1.7860	51.099	1.7860	13	49	1.8	9	1.6	0.165
29:	51.779	1.7642	51.780	1.7641	14	193	7.1	43	7.4	0.201
30:	52.859	1.7306	52.867	1.7304	17	56	2.1	14	2.4	0.225
31:	53.841	1.7014	53.839	1.7014	27	170	6.3	57	9.8	0.302
32:	54.739	1.6756	54.741	1.6755	22	157	5.8	31	5.4	0.178
33:	55.218	1.6622	55.215	1.6622	22	216	8.0	67	11.6	0.279
34:	55.958	1.6419	55.960	1.6419	26	360	13.3	84	14.5	0.210
35:	57.580	1.5995	57.577	1.5995	21	126	4.7	42	7.3	0.300
36:	58.378	1.5795	58.382	1.5794	21	131	4.8	37	6.4	0.254
37:	58.978	1.5648	58.978	1.5648	21	36	1.3	7	1.2	0.175
38:	59.698	1.5477	59.699	1.5477	18	72	2.7	7	1.2	0.087
39:	60.657	1.5255	60.666	1.5253	18	56	2.1	18	3.1	0.289
40:	61.281	1.5114	61.294	1.5111	16	148	5.5	46	7.9	0.280
41:	62.018	1.4952	62.022	1.4951	14	94	3.5	29	5.0	0.278
42:	63.243	1.4692	63.252	1.4690	13	88	3.3	18	3.1	0.184
43:	64.060	1.4524	64.068	1.4522	12	53	2.0	16	2.8	0.272

#	2Theta	d	2Theta	d	Bkgrd	Peak	I%	Area	I%	FWHM*
44:	66.538	1.4042	66.538	1.4042	16	170	6.3	42	7.3	0.222
45:	68.222	1.3736	68.225	1.3735	26	42	1.6	12	2.1	0.257
[illegible]:	68.339	1.3715	68.323	1.3718	26	36	1.3	9	1.6	0.225
47:	69.262	1.3555	69.280	1.3552	39	92	3.4	20	3.5	0.196
48:	69.417	1.3528	69.416	1.3528	41	92	3.4	22	3.8	0.215

* Intensity values are based on total raw counts.

========== Southwest Research Institute ==========

Jade: Peak Listing Wed Nov 15 1995 @3:25pm

File: SODD6.MDI> SODD6 * XRD

Scan Parameters:	Search Parameters:
Radiation = CU_1.54059	Filter length(pts) = 25
Scan Range = 2- 70	Noise level(sigmas) = 3.0
Step Size = .02	Intensity cutoff(%) = 1.0-100
Count Time = 2 sec.	2-Theta Zero (degs) = 0

	Peak-Position		Centroid-Position		Peak & Area are without Bkgrd					
#	2Theta	d	2Theta	d	Bkgrd	Peak	I%	Area	I%	FWHM*
1:	14.221	6.2230	14.183	6.2396	36	2136	81.5	509	73.2	0.214
2:	18.521	4.7868	18.502	4.7916	27	695	26.5	188	27.1	0.243
3:	19.125	4.6370	19.122	4.6376	26	224	8.5	58	8.3	0.233
4:	19.641	4.5162	19.612	4.5228	25	2622	100.0	607	87.3	0.208
5:	23.620	3.7637	23.604	3.7661	17	414	15.8	97	14.0	0.211
6:	26.822	3.3212	26.788	3.3254	17	2440	93.1	695	100.0	0.256
7:	27.538	3.2364	27.512	3.2395	17	697	26.6	154	22.2	0.199
8:	29.940	2.9820	29.931	2.9829	16	595	22.7	147	21.2	0.222
9:	31.900	2.8031	31.898	2.8033	18	314	12.0	93	13.4	0.267
10:	33.060	2.7074	33.058	2.7075	13	1303	49.7	302	43.5	0.209
11:	33.860	2.6452	33.869	2.6445	17	164	6.3	32	4.6	0.176
12:	35.686	2.5139	35.684	2.5141	17	69	2.6	8	1.2	0.104
13:	36.241	2.4767	36.252	2.4760	14	778	29.7	176	25.3	0.204
14:	36.579	2.4546	36.572	2.4550	13	447	17.0	116	16.7	0.234
15:	37.436	2.4003	37.444	2.3999	18	64	2.4	11	1.6	0.155
16:	38.759	2.3214	38.764	2.3211	13	255	9.7	46	6.6	0.162
17:	40.020	2.2511	40.010	2.2516	16	280	10.7	76	10.9	0.244
18:	40.940	2.2026	40.955	2.2019	15	199	7.6	46	6.6	0.208
19:	41.559	2.1713	41.565	2.1710	17	93	3.5	19	2.7	0.184
20:	43.298	2.0880	43.298	2.0880	16	546	20.8	147	21.2	0.242
21:	43.801	2.0652	43.802	2.0651	14	249	9.5	58	8.3	0.210
22:	44.240	2.0457	44.237	2.0458	14	247	9.4	79	11.4	0.288
23:	45.978	1.9723	45.989	1.9719	13	414	15.8	96	13.8	0.209
24:	47.779	1.9021	47.791	1.9017	24	347	13.2	119	17.1	0.309
25:	48.238	1.8850	48.237	1.8851	15	158	6.0	45	6.5	0.256
26:	48.980	1.8582	48.987	1.8580	14	608	23.2	180	25.9	0.266
27:	50.960	1.7906	50.972	1.7902	14	53	2.0	12	1.7	0.204
28:	51.700	1.7667	51.706	1.7665	14	227	8.7	58	8.3	0.230
29:	52.740	1.7343	52.754	1.7338	18	69	2.6	15	2.2	0.196
30:	53.721	1.7049	53.722	1.7048	27	197	7.5	61	8.8	0.279
31:	54.661	1.6778	54.668	1.6776	24	169	6.4	49	7.1	0.261
32:	55.119	1.6649	55.126	1.6647	22	255	9.7	78	11.2	0.275
33:	55.876	1.6441	55.894	1.6436	26	460	17.5	122	17.6	0.239
34:	57.460	1.6025	57.468	1.6023	18	139	5.3	50	7.2	0.324
35:	58.277	1.5820	58.279	1.5819	18	164	6.3	43	6.2	0.236
36:	58.856	1.5678	58.852	1.5679	18	52	2.0	16	2.3	0.277
37:	59.616	1.5496	59.637	1.5491	18	85	3.2	24	3.5	0.254
38:	60.540	1.5281	60.557	1.5277	17	53	2.0	18	2.6	0.306
39:	61.200	1.5132	61.201	1.5132	16	159	6.1	53	7.6	0.300
40:	61.959	1.4965	61.952	1.4967	18	93	3.5	29	4.2	0.281
41:	63.196	1.4702	63.211	1.4699	15	81	3.1	25	3.6	0.278
42:	63.941	1.4548	63.945	1.4547	14	43	1.6	14	2.0	0.293
43:	66.458	1.4057	66.459	1.4057	20	175	6.7	34	4.9	0.175

#	2Theta	d	2Theta	d	Bkgrd	Peak	I%	Area	I%	FWHM*
44:	68.176	1.3744	68.178	1.3744	26	45	1.7	10	1.4	0.200
45:	69.282	1.3551	69.273	1.3553	39	164	6.3	27	3.9	0.148
46:	69.400	1.3531	69.400	1.3531	41	80	3.1	19	2.7	0.214

* Intensity values are based on total raw counts.

========== Southwest Research Institute ==========

Jade: Peak Listing Wed Nov 15 1995 @3:27pm

File: SODD7.MDI> SODD7 * XRD

Scan Parameters:	Search Parameters:
Radiation = CU_1.54059	Filter length(pts) = 25
Scan Range = 2- 70	Noise level(sigmas) = 3.0
Step Size = .02	Intensity cutoff(%) = 1.0-100
Count Time = 2 sec.	2-Theta Zero (degs) = 0

	Peak-Position		Centroid-Position		Peak & Area are without Bkgrd					
#	2Theta	d	2Theta	d	Bkgrd	Peak	I%	Area	I%	FWHM*
1:	14.201	6.2317	14.171	6.2447	29	2214	75.7	510	80.7	0.207
2:	18.519	4.7872	18.493	4.7938	25	755	25.8	186	29.4	0.222
3:	19.124	4.6371	19.137	4.6341	24	308	10.5	83	13.1	0.243
4:	19.621	4.5207	19.601	4.5254	23	2926	100.0	610	96.5	0.188
5:	23.601	3.7667	23.586	3.7689	16	397	13.6	91	14.4	0.206
6:	26.802	3.3236	26.774	3.3270	15	2424	82.8	632	100.0	0.235
7:	27.501	3.2407	27.497	3.2412	18	780	26.7	147	23.3	0.170
8:	29.938	2.9822	29.926	2.9834	18	634	21.7	152	24.1	0.216
9:	31.861	2.8064	31.882	2.8047	19	341	11.7	93	14.7	0.245
10:	33.022	2.7104	33.044	2.7087	13	1315	44.9	300	47.5	0.205
11:	33.861	2.6452	33.852	2.6459	16	140	4.8	28	4.4	0.180
12:	35.740	2.5102	35.755	2.5092	17	78	2.7	20	3.2	0.231
13:	36.239	2.4769	36.259	2.4755	15	709	24.2	169	26.7	0.215
14:	36.580	2.4546	36.580	2.4545	14	411	14.0	77	12.2	0.169
15:	37.457	2.3991	37.451	2.3994	16	59	2.0	14	2.2	0.214
16:	38.739	2.3226	38.755	2.3216	15	313	10.7	53	8.4	0.152
17:	39.979	2.2533	39.981	2.2532	17	266	9.1	70	11.1	0.237
18:	40.940	2.2026	40.943	2.2025	16	241	8.2	43	6.8	0.161
19:	41.560	2.1712	41.564	2.1710	19	92	3.1	16	2.5	0.157
20:	42.001	2.1494	41.999	2.1495	17	35	1.2	8	1.3	0.206
21:	43.279	2.0888	43.280	2.0888	13	538	18.4	151	23.9	0.253
22:	43.780	2.0661	43.784	2.0659	14	193	6.6	67	10.6	0.312
23:	44.219	2.0466	44.224	2.0464	15	212	7.2	77	12.2	0.327
24:	45.960	1.9731	45.977	1.9723	16	455	15.6	99	15.7	0.196
25:	47.740	1.9036	47.758	1.9029	23	352	12.0	131	20.7	0.335
26:	48.220	1.8857	48.212	1.8860	16	162	5.5	57	9.0	0.317
27:	48.961	1.8589	48.971	1.8585	15	621	21.2	195	30.9	0.283
28:	51.679	1.7673	51.701	1.7666	15	212	7.2	58	9.2	0.246
29:	52.761	1.7336	52.759	1.7337	19	63	2.2	17	2.7	0.243
30:	53.681	1.7060	53.697	1.7056	25	203	6.9	31	4.9	0.137
31:	54.662	1.6777	54.662	1.6777	27	175	6.0	37	5.9	0.190
32:	55.118	1.6649	55.105	1.6653	19	247	8.4	81	12.8	0.295
33:	55.840	1.6451	55.877	1.6441	22	389	13.3	114	18.0	0.264
34:	57.459	1.6025	57.470	1.6023	18	132	4.5	51	8.1	0.348
35:	58.278	1.5819	58.294	1.5815	20	156	5.3	49	7.8	0.283
36:	58.838	1.5682	58.825	1.5685	22	58	2.0	16	2.5	0.248
37:	59.598	1.5500	59.599	1.5500	23	70	2.4	17	2.7	0.219
38:	60.519	1.5286	60.530	1.5284	20	59	2.0	18	2.8	0.275
39:	61.199	1.5133	61.202	1.5132	18	160	5.5	59	9.3	0.332
40:	61.922	1.4973	61.920	1.4974	16	96	3.3	32	5.1	0.300
41:	63.220	1.4697	63.220	1.4697	15	87	3.0	23	3.6	0.238
42:	63.879	1.4561	63.883	1.4560	14	41	1.4	16	2.5	0.351
43:	64.060	1.4524	64.049	1.4526	14	51	1.7	18	2.8	0.318

#	2Theta	d	2Theta	d	Bkgrd	Peak	I%	Area	I%	FWHM*
44:	65.177	1.4302	65.176	1.4302	14	33	1.1	8	1.3	0.218
45:	66.435	1.4061	66.438	1.4061	20	197	6.7	49	7.8	0.224
[illegible]:	68.178	1.3744	68.178	1.3743	26	55	1.9	11	1.7	0.180
47:	69.100	1.3582	69.099	1.3583	47	89	3.0	19	3.0	0.192
48:	69.203	1.3565	69.224	1.3561	49	108	3.7	17	2.7	0.142
49:	69.359	1.3538	69.359	1.3538	51	109	3.7	8	1.3	0.066

* Intensity values are based on total raw counts.

SODDYITE SYNTHESIS

WRITTEN BY: J.D. Prikryl
REVISION NO.: 2

DATE WRITTEN: July 3, 1995
DATE REVISED: Oct 31, 1995

OBJECTIVE: to synthesize soddyite [$(UO_2)_2SiO_4.2H_2O$] for use in thermodynamic experiments of uranyl silicate minerals for the near-field geochemistry project.

EQUIPMENT:
Parr stainless steel reaction vessels (Model 4913EB; 2000 ml capacity)
Teflon liners for reaction vessels
Parr Model 4841 or 4843 temperature controllers
Type J themocouples (teflon coated)
ORION ph/mV/ISE/^{o}C meter
Combination ph electrode
Automatic termperature compensator probe
Analytical balance (Mettler PM 4600)
Hot plate (Thermolyne Type 13100)

SUPPLIES:
pH buffers (pH= 1,2,4)
ultrapure water
glassware and platicware as needed
Fittings, valves, and tubing as necessary

REAGENTS:
Uranyl acetate dihydrate [$UO_2(CH_3COO_2.2H_2O)$]; MW=424.15 (lot 337419/1 1094)
Silicic acid [$SiO_2.nH_2O$]; MW depends on H_2O content; assume no H_2O; MW = 60 (lot 951303)
9 M HCl - diluted from lot 945500

PROCEDURE:

Reagents for soddyite synthesis will be mixed in the stoichiometric ratio U:Si = 1:2.

a) Place 42 g U-acetate and 12 g silicic acid (coarse fraction separated by density settling in a 2000 ml teflon liner.

b) Transfer approximately 1500 g of ultrapure H_2O to a 2000 ml erlenmeyer flask and degas the H_2O by boiling on a hotplate.

c) Transfer approximately 1300 g of the degassed H_2O to the teflon liner and place in pressure vessel.

d) Raise and set the temperature of the solution in the reaction vessel to 150C using the temperature controller.

e) Degas the pressure vessel once it reaches about >140C by opening the air intake value attached to the pressure gauge assembly.

f) Close intake value after degassing and allow the reagents to react for about 10 days.

========== Southwest Research Institute ==========

Jade: Peak Listing — Sat Oct 14 1995 @1:20pm

File: URAN9A.MDI> URAN9A * XRD

Scan Parameters:

Radiation = CU_1.54059
Scan Range = 2- 70
Step Size = .02
Count Time = 2 sec.

Search Parameters:

Filter length(pts) = 25
Noise level(sigmas) = 3.0
Intensity cutoff(%) = 1.0-100
2-Theta Zero (degs) = 0

	Peak-Position		Centroid-Position		Peak & Area are without Bkgrd					
#	2Theta	d	2Theta	d	Bkgrd	Peak	I%	Area	I%	FWHM*
1:	11.239	7.8663	11.206	7.8895	61	2757	100.0	603	100.0	0.197
2:	13.419	6.5930	13.394	6.6053	52	782	28.4	156	25.9	0.180
3:	16.359	5.4143	16.339	5.4208	45	763	27.7	169	28.0	0.199
4:	18.479	4.7976	18.475	4.7987	39	943	34.2	254	42.1	0.242
5:	20.720	4.2833	20.712	4.2850	35	290	10.5	57	9.5	0.177
6:	22.559	3.9381	22.547	3.9404	34	1806	65.5	382	63.3	0.190
7:	24.741	3.5957	24.742	3.5955	34	531	19.3	105	17.4	0.178
8:	25.458	3.4960	25.468	3.4946	34	721	26.2	173	28.7	0.216
9:	26.839	3.3191	26.842	3.3188	38	91	3.3	17	2.8	0.168
10:	27.879	3.1976	27.872	3.1984	39	1028	37.3	221	36.7	0.193
11:	28.819	3.0954	28.821	3.0952	41	110	4.0	15	2.5	0.123
12:	29.881	2.9878	29.881	2.9878	43	1199	43.5	262	43.4	0.197
13:	30.683	2.9115	30.684	2.9114	44	839	30.4	193	32.0	0.207
14:	31.680	2.8221	31.681	2.8220	52	98	3.6	15	2.5	0.138
15:	33.260	2.6916	33.256	2.6919	44	461	16.7	105	17.4	0.205
16:	34.121	2.6256	34.122	2.6255	38	377	13.7	87	14.4	0.208
17:	35.057	2.5576	35.064	2.5571	39	118	4.3	16	2.7	0.122
18:	35.482	2.5279	35.491	2.5273	36	189	6.9	38	6.3	0.181
19:	35.831	2.5041	35.833	2.5039	33	82	3.0	9	1.5	0.099
20:	37.422	2.4012	37.432	2.4006	25	59	2.1	12	2.0	0.183
21:	39.920	2.2565	39.913	2.2569	29	165	6.0	31	5.1	0.169
22:	40.601	2.2203	40.621	2.2192	27	98	3.6	20	3.3	0.184
23:	40.979	2.2006	40.995	2.1998	29	392	14.2	127	21.1	0.292
24:	42.179	2.1408	42.168	2.1413	34	56	2.0	10	1.7	0.161
25:	43.062	2.0989	43.078	2.0982	34	485	17.6	147	24.4	0.273
26:	44.080	2.0527	44.053	2.0539	33	140	5.1	49	8.1	0.315
27:	45.983	1.9721	45.982	1.9722	37	258	9.4	36	6.0	0.126
28:	46.360	1.9570	46.360	1.9570	36	244	8.9	47	7.8	0.173
29:	47.660	1.9066	47.688	1.9055	40	224	8.1	77	12.8	0.309
30:	48.260	1.8842	48.256	1.8844	40	203	7.4	52	8.6	0.231
31:	48.760	1.8661	48.757	1.8662	41	230	8.3	87	14.4	0.340
32:	49.961	1.8240	49.969	1.8237	39	116	4.2	30	5.0	0.233
33:	50.461	1.8071	50.464	1.8070	35	50	1.8	12	2.0	0.216
34:	50.597	1.8026	50.588	1.8029	34	38	1.4	7	1.2	0.166
35:	51.700	1.7667	51.688	1.7670	53	161	5.8	53	8.8	0.296
36:	52.299	1.7479	52.308	1.7476	40	164	5.9	54	9.0	0.296
37:	52.480	1.7422	52.474	1.7424	41	152	5.5	48	8.0	0.284
38:	52.555	1.7399	52.556	1.7399	41	115	4.2	28	4.6	0.219
39:	53.559	1.7097	53.551	1.7099	64	106	3.8	22	3.6	0.187
40:	55.219	1.6621	55.220	1.6621	41	101	3.7	35	5.8	0.312
41:	55.640	1.6505	55.640	1.6505	41	89	3.2	19	3.2	0.192
42:	57.401	1.6040	57.400	1.6040	42	66	2.4	12	2.0	0.164
43:	57.560	1.6000	57.556	1.6001	38	109	4.0	43	7.1	0.355

#	2Theta	d	2Theta	d	Bkgrd	Peak	I%	Area	I%	FWHM*
44:	58.422	1.5784	58.421	1.5784	32	115	4.2	31	5.1	0.243
45:	60.159	1.5369	60.159	1.5369	25	86	3.1	24	4.0	0.251
46:	60.281	1.5341	60.280	1.5341	25	82	3.0	22	3.6	0.241
47:	61.720	1.5017	61.722	1.5017	29	94	3.4	21	3.5	0.201
48:	62.039	1.4948	62.040	1.4947	31	97	3.5	20	3.3	0.186
49:	62.165	1.4921	62.159	1.4922	31	106	3.8	46	7.6	0.391
50:	63.720	1.4593	63.720	1.4593	37	93	3.4	15	2.5	0.145
51:	63.799	1.4577	63.819	1.4573	37	83	3.0	35	5.8	0.380
52:	64.760	1.4384	64.763	1.4383	26	131	4.8	52	8.6	0.357
53:	64.797	1.4376	64.787	1.4378	25	141	5.1	48	8.0	0.306
54:	68.320	1.3718	68.320	1.3718	39	46	1.7	7	1.2	0.137

* Intensity values are based on total raw counts.

========== Southwest Research Institute ==========

Jade: Peak Listing Mon Oct 23 1995 @1:14pm

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File: URAN10A.MDI> URAN10A - XRD

Scan Parameters:	Search Parameters:
Radiation = CU_1.54059	Filter length(pts) = 25
Scan Range = 2- 70	Noise level(sigmas) = 5.0
Step Size = .02	Intensity cutoff(%) = .5-100
Count Time = 2 sec.	2-Theta Zero (degs) = 0

	Peak-Position		Centroid-Position		Peak & Area are without Bkgrd					
#	2Theta	d	2Theta	d	Bkgrd	Peak	I%	Area	I%	FWHM*
1:	11.261	7.8512	11.234	7.8696	53	2749	100.0	808	100.0	0.265
2:	13.441	6.5825	13.418	6.5937	51	796	29.0	209	25.9	0.236
3:	16.380	5.4073	16.363	5.4128	46	737	26.8	212	26.2	0.259
4:	18.519	4.7871	18.512	4.7891	41	816	29.7	258	31.9	0.285
5:	20.740	4.2793	20.738	4.2797	39	205	7.5	52	6.4	0.228
6:	22.600	3.9311	22.580	3.9346	33	1929	70.2	518	64.1	0.242
7:	24.799	3.5874	24.777	3.5904	30	574	20.9	141	17.5	0.221
8:	25.500	3.4904	25.493	3.4913	32	415	15.1	115	14.2	0.249
9:	26.983	3.3018	26.984	3.3017	35	80	2.9	14	1.7	0.157
10:	27.920	3.1930	27.904	3.1948	36	663	24.1	177	21.9	0.240
11:	28.839	3.0933	28.840	3.0933	40	73	2.7	6	0.7	0.074
12:	29.921	2.9839	29.919	2.9841	46	1183	43.0	303	37.5	0.231
13:	30.759	2.9045	30.726	2.9075	47	798	29.0	237	29.3	0.267
14:	31.756	2.8155	31.756	2.8155	55	70	2.5	5	0.6	0.064
15:	33.301	2.6883	33.294	2.6889	48	465	16.9	119	14.7	0.230
16:	34.160	2.6226	34.170	2.6219	45	430	15.6	110	13.6	0.230
17:	35.102	2.5544	35.111	2.5538	37	114	4.1	29	3.6	0.229
18:	35.520	2.5253	35.526	2.5249	34	193	7.0	55	6.8	0.256
19:	37.442	2.4000	37.440	2.4001	21	63	2.3	14	1.7	0.200
20:	39.941	2.2554	39.949	2.2550	24	161	5.9	42	5.2	0.235
21:	41.001	2.1995	41.018	2.1986	28	418	15.2	142	17.6	0.306
22:	43.139	2.0953	43.134	2.0956	34	503	18.3	152	18.8	0.272
23:	44.099	2.0519	44.088	2.0524	37	180	6.5	65	8.0	0.325
24:	44.499	2.0344	44.500	2.0344	37	64	2.3	7	0.9	0.098
25:	46.060	1.9690	46.060	1.9690	36	335	12.2	73	9.0	0.196
26:	46.378	1.9562	46.379	1.9562	35	296	10.8	100	12.4	0.304
27:	47.700	1.9051	47.705	1.9049	37	178	6.5	59	7.3	0.298
28:	48.299	1.8828	48.296	1.8829	40	167	6.1	66	8.2	0.356
29:	48.800	1.8647	48.796	1.8648	44	249	9.1	84	10.4	0.304
30:	50.039	1.8214	50.038	1.8214	49	107	3.9	20	2.5	0.168
31:	51.701	1.7666	51.701	1.7667	54	164	6.0	28	3.5	0.154
32:	52.320	1.7472	52.322	1.7471	42	153	5.6	66	8.2	0.388
33:	52.420	1.7441	52.418	1.7442	42	152	5.5	84	10.4	0.497
34:	52.538	1.7404	52.539	1.7404	41	138	5.0	44	5.4	0.287
35:	53.320	1.7168	53.321	1.7167	61	64	2.3	9	1.1	0.127
36:	53.360	1.7156	53.359	1.7156	60	69	2.5	6	0.7	0.078
37:	53.461	1.7125	53.464	1.7125	59	68	2.5	25	3.1	0.331
38:	53.561	1.7096	53.552	1.7099	57	90	3.3	18	2.2	0.180
39:	55.261	1.6609	55.271	1.6607	39	124	4.5	34	4.2	0.247
40:	55.596	1.6517	55.599	1.6517	39	114	4.1	34	4.2	0.268
41:	57.600	1.5989	57.600	1.5989	38	102	3.7	27	3.3	0.238
42:	58.521	1.5760	58.521	1.5759	35	166	6.0	33	4.1	0.179
43:	59.040	1.5633	59.043	1.5633	40	71	2.6	14	1.7	0.177

#	2Theta	d	2Theta	d	Bkgrd	Peak	I%	Area	I%	FWHM*
44:	59.100	1.5619	59.099	1.5619	39	73	2.7	17	2.1	0.210
45:	60.238	1.5351	60.239	1.5351	28	107	3.9	32	4.0	0.269
46:	61.721	1.5017	61.721	1.5017	28	75	2.7	7	0.9	0.084
47:	61.799	1.5000	61.802	1.4999	28	95	3.5	25	3.1	0.237
48:	61.942	1.4969	61.941	1.4969	28	98	3.6	31	3.8	0.285
49:	62.041	1.4947	62.041	1.4947	29	127	4.6	52	6.4	0.369
50:	62.138	1.4926	62.130	1.4928	29	100	3.6	57	7.1	0.513
51:	62.201	1.4913	62.199	1.4913	29	112	4.1	49	6.1	0.394
52:	62.299	1.4891	62.274	1.4897	29	113	4.1	35	4.3	0.279
53:	63.879	1.4561	63.880	1.4561	31	116	4.2	20	2.5	0.155
54:	64.800	1.4376	64.802	1.4376	26	140	5.1	54	6.7	0.347
55:	67.740	1.3822	67.744	1.3821	31	43	1.6	6	0.7	0.126
56:	68.480	1.3690	68.480	1.3690	35	44	1.6	4	0.5	0.082

* Intensity values are based on total raw counts.

========== Southwest Research Institute ==========

Jade: Peak Listing Thu Sep 28 1995 @1:55pm

File: URAN7A.MDI> URAN7A * XRD

Scan Parameters:	Search Parameters:
Radiation = CU_1.54059	Filter length(pts) = 25
Scan Range = 2- 70	Noise level(sigmas) = 3.0
Step Size = .02	Intensity cutoff(%) = 1.0-100
Count Time = 2 sec.	2-Theta Zero (degs) = 0

	Peak-Position		Centroid-Position		Peak & Area are without Bkgrd					
#	2Theta	d	2Theta	d	Bkgrd	Peak	I%	Area	I%	FWHM*
1:	11.220	7.8796	11.215	7.8833	43	1216	10.7	327	12.3	0.242
2:	11.881	7.4429	11.879	7.4439	44	11370	100.0	2664	100.0	0.211
3:	13.421	6.5921	13.421	6.5921	45	581	5.1	164	6.2	0.254
4:	16.320	5.4269	16.319	5.4272	37	256	2.3	81	3.0	0.285
5:	18.480	4.7972	18.483	4.7965	34	302	2.7	87	3.3	0.259
6:	19.000	4.6672	19.000	4.6672	32	220	1.9	31	1.2	0.127
7:	22.561	3.9379	22.547	3.9403	42	625	5.5	153	5.7	0.220
8:	23.918	3.7175	23.888	3.7221	53	3473	30.5	639	24.0	0.166
9:	24.740	3.5957	24.740	3.5957	40	520	4.6	104	3.9	0.180
10:	25.143	3.5391	25.136	3.5401	37	202	1.8	46	1.7	0.205
11:	25.458	3.4960	25.458	3.4960	42	159	1.4	37	1.4	0.209
12:	27.899	3.1954	27.888	3.1966	35	607	5.3	140	5.3	0.208
13:	29.920	2.9840	29.915	2.9845	42	533	4.7	137	5.1	0.231
14:	30.721	2.9080	30.720	2.9081	40	397	3.5	126	4.7	0.286
15:	33.338	2.6855	33.326	2.6864	30	150	1.3	39	1.5	0.234
16:	34.120	2.6257	34.126	2.6252	34	145	1.3	30	1.1	0.186
17:	34.943	2.5657	34.954	2.5649	34	211	1.9	42	1.6	0.179
18:	35.422	2.5321	35.436	2.5311	29	146	1.3	43	1.6	0.265
19:	36.160	2.4820	36.148	2.4829	32	324	2.8	62	2.3	0.172
20:	36.760	2.4429	36.757	2.4431	36	235	2.1	41	1.5	0.157
21:	41.020	2.1985	41.034	2.1978	24	218	1.9	65	2.4	0.268
22:	43.040	2.0999	43.051	2.0994	38	255	2.2	91	3.4	0.321
23:	44.518	2.0335	44.525	2.0332	47	220	1.9	47	1.8	0.192
24:	48.857	1.8626	48.857	1.8626	44	203	1.8	47	1.8	0.208
25:	49.318	1.8463	49.322	1.8462	44	195	1.7	31	1.2	0.143

* Intensity values are based on total raw counts.

========== Southwest Research Institute ==========

Jade: Peak Listing Thu Sep 28 1995 @1:58pm

File: URAN7B.MDI> URAN7B * XRD

Scan Parameters:	Search Parameters:
Radiation = CU_1.54059	Filter length(pts) = 25
Scan Range = 2- 70	Noise level(sigmas) = 3.0
Step Size = .02	Intensity cutoff(%) = 1.0-100
Count Time = 2 sec.	2-Theta Zero (degs) = 0

	Peak-Position		Centroid-Position		Peak & Area are without Bkgrd					
#	2Theta	d	2Theta	d	Bkgrd	Peak	I%	Area	I%	FWHM*
1:	11.178	7.9091	11.158	7.9236	42	2170	100.0	448	100.0	0.186
2:	11.839	7.4694	11.823	7.4790	44	643	29.6	108	24.1	0.151
3:	13.341	6.6313	13.330	6.6367	49	649	29.9	122	27.2	0.169
4:	15.342	5.7705	15.342	5.7707	52	65	3.0	10	2.2	0.138
5:	16.297	5.4346	16.281	5.4400	55	527	24.3	100	22.3	0.171
6:	18.401	4.8177	18.422	4.8123	37	679	31.3	161	35.9	0.213
7:	20.641	4.2996	20.646	4.2986	36	184	8.5	35	7.8	0.171
8:	21.103	4.2066	21.097	4.2078	40	47	2.2	5	1.1	0.096
9:	22.481	3.9516	22.485	3.9510	40	1292	59.5	255	56.9	0.178
10:	22.995	3.8645	22.996	3.8644	39	49	2.3	5	1.1	0.092
11:	23.803	3.7352	23.809	3.7342	60	119	5.5	12	2.7	0.091
12:	24.680	3.6043	24.680	3.6044	60	370	17.1	66	14.7	0.161
13:	25.416	3.5017	25.410	3.5024	59	367	16.9	80	17.9	0.196
14:	27.341	3.2593	27.346	3.2587	60	67	3.1	9	2.0	0.121
15:	27.838	3.2023	27.823	3.2039	57	595	27.4	124	27.7	0.188
16:	28.782	3.0993	28.784	3.0991	50	71	3.3	8	1.8	0.101
17:	29.839	2.9919	29.834	2.9924	46	902	41.6	177	39.5	0.177
18:	30.640	2.9155	30.638	2.9157	44	655	30.2	144	32.1	0.198
19:	31.620	2.8273	31.620	2.8273	51	48	2.2	5	1.1	0.094
20:	33.220	2.6947	33.213	2.6953	44	357	16.5	75	16.7	0.189
21:	34.100	2.6271	34.100	2.6271	43	218	10.0	38	8.5	0.157
22:	34.959	2.5645	34.960	2.5644	39	83	3.8	14	3.1	0.152
23:	35.420	2.5322	35.433	2.5313	35	164	7.6	34	7.6	0.187
24:	37.301	2.4087	37.301	2.4088	28	55	2.5	9	2.0	0.147
25:	39.861	2.2597	39.876	2.2589	36	137	6.3	28	6.3	0.184
26:	40.920	2.2037	40.939	2.2027	34	283	13.0	101	22.5	0.321
27:	42.100	2.1446	42.100	2.1446	36	38	1.8	5	1.1	0.118
28:	43.057	2.0991	43.041	2.0999	38	361	16.6	102	22.8	0.254
29:	43.999	2.0563	44.004	2.0561	36	107	4.9	28	6.3	0.236
30:	44.402	2.0386	44.394	2.0389	37	69	3.2	18	4.0	0.235
31:	45.943	1.9738	45.945	1.9737	38	202	9.3	34	7.6	0.151
32:	46.279	1.9602	46.273	1.9604	37	181	8.3	56	12.5	0.278
33:	47.619	1.9081	47.627	1.9078	40	155	7.1	42	9.4	0.244
34:	48.179	1.8872	48.181	1.8871	44	128	5.9	35	7.8	0.246
35:	48.700	1.8683	48.704	1.8681	41	174	8.0	63	14.1	0.326
36:	49.902	1.8260	49.905	1.8259	49	60	2.8	13	2.9	0.195
37:	51.661	1.7679	51.655	1.7681	48	130	6.0	35	7.8	0.242
38:	52.161	1.7521	52.160	1.7522	41	102	4.7	18	4.0	0.159
39:	52.198	1.7510	52.204	1.7508	41	83	3.8	26	5.8	0.282
40:	52.433	1.7437	52.437	1.7436	41	91	4.2	28	6.3	0.277
41:	53.422	1.7137	53.421	1.7137	47	54	2.5	7	1.6	0.117
42:	53.560	1.7096	53.560	1.7096	45	57	2.6	9	2.0	0.142
43:	55.198	1.6627	55.198	1.6627	40	101	4.7	25	5.6	0.223

#	2Theta	d	2Theta	d	Bkgrd	Peak	I%	Area	I%	FWHM*
44:	55.534	1.6534	55.528	1.6536	40	58	2.7	25	5.6	0.388
45:	57.481	1.6020	57.488	1.6018	40	71	3.3	19	4.2	0.241
[illegible]:	58.480	1.5770	58.479	1.5770	41	71	3.3	20	4.5	0.254
47:	60.118	1.5379	60.118	1.5378	34	64	2.9	18	4.0	0.253
48:	61.698	1.5022	61.699	1.5022	35	69	3.2	9	2.0	0.117
49:	62.044	1.4947	62.045	1.4946	37	43	2.0	24	5.4	0.502
50:	62.140	1.4926	62.138	1.4926	37	76	3.5	17	3.8	0.201
51:	63.720	1.4593	63.722	1.4593	38	60	2.8	9	2.0	0.135
52:	63.820	1.4573	63.819	1.4573	38	66	3.0	14	3.1	0.191
53:	64.701	1.4395	64.703	1.4395	33	80	3.7	17	3.8	0.191
54:	64.820	1.4372	64.820	1.4372	33	62	2.9	8	1.8	0.116
55:	68.401	1.3704	68.400	1.3704	30	35	1.6	8	1.8	0.206

* Intensity values are based on total raw counts.

========== Southwest Research Institute ==========

Jade: Peak Listing Thu Sep 28 1995 @2:01pm

File: URAN8A.MDI> URAN8A * XRD

Scan Parameters:	Search Parameters:
Radiation = CU_1.54059	Filter length(pts) = 25
Scan Range = 2- 70	Noise level(sigmas) = 3.0
Step Size = .02	Intensity cutoff(%) = 1.0-100
Count Time = 2 sec.	2-Theta Zero (degs) = 0

	Peak-Position		Centroid-Position		Peak & Area are without Bkgrd					
#	2Theta	d	2Theta	d	Bkgrd	Peak	I%	Area	I%	FWHM*
1:	11.320	7.8104	11.322	7.8087	39	963	2.9	258	3.3	0.241
2:	12.021	7.3563	11.995	7.3724	46	33078	100.0	7853	100.0	0.214
3:	13.541	6.5338	13.535	6.5366	45	503	1.5	126	1.6	0.225
4:	22.679	3.9176	22.658	3.9213	28	525	1.6	114	1.5	0.195
5:	24.019	3.7021	23.999	3.7051	34	12966	39.2	2439	31.1	0.169
6:	24.860	3.5786	24.851	3.5800	29	899	2.7	189	2.4	0.189
7:	30.799	2.9008	30.815	2.8993	16	458	1.4	113	1.4	0.222
8:	36.261	2.4754	36.271	2.4747	20	1194	3.6	212	2.7	0.160
9:	36.859	2.4366	36.870	2.4359	24	955	2.9	171	2.2	0.161
10:	43.078	2.0982	43.108	2.0968	25	342	1.0	94	1.2	0.247

* Intensity values are based on total raw counts.

========== Southwest Research Institute ==========

Jade: Peak Listing Thu Sep 28 1995 @2:10pm

File: URAN8B.MDI> URAN8B * XRD

Scan Parameters:	Search Parameters:
Radiation = CU_1.54059	Filter length(pts) = 25
Scan Range = 2- 70	Noise level(sigmas) = 3.0
Step Size = .02	Intensity cutoff(%) = 1.0-100
Count Time = 2 sec.	2-Theta Zero (degs) = 0

	Peak-Position		Centroid-Position		Peak & Area are without Bkgrd					
#	2Theta	d	2Theta	d	Bkgrd	Peak	I%	Area	I%	FWHM*
1:	5.683	15.5373	5.668	15.5787	39	140	15.8	23	16.4	0.148
2:	6.189	14.2685	6.194	14.2579	43	55	6.2	12	8.6	0.196
3:	8.618	10.2522	8.619	10.2505	25	66	7.4	24	17.1	0.327
4:	11.024	8.0194	11.020	8.0222	26	256	28.8	37	26.4	0.130
5:	11.666	7.5797	11.664	7.5806	26	203	22.9	51	36.4	0.226
6:	12.209	7.2436	12.211	7.2426	26	742	83.6	140	100.0	0.170
7:	12.233	7.2293	12.229	7.2321	26	888	100.0	108	77.1	0.109
8:	12.513	7.0685	12.513	7.0681	25	81	9.1	7	5.0	0.078
9:	13.143	6.7310	13.142	6.7311	31	45	5.1	4	2.9	0.080
10:	13.501	6.5531	13.501	6.5533	29	106	11.9	14	10.0	0.119
11:	13.537	6.5357	13.534	6.5371	28	122	13.7	21	15.0	0.155
12:	13.866	6.3815	13.866	6.3815	26	38	4.3	3	2.1	0.071
13:	14.442	6.1282	14.443	6.1277	33	215	24.2	34	24.3	0.142
14:	14.773	5.9916	14.766	5.9945	40	112	12.6	12	8.6	0.096
15:	15.346	5.7694	15.358	5.7646	35	105	11.8	19	13.6	0.163
16:	15.742	5.6250	15.742	5.6250	33	271	30.5	68	48.6	0.226
17:	15.859	5.5836	15.850	5.5870	34	269	30.3	103	73.6	0.345
18:	16.321	5.4266	16.305	5.4321	34	136	15.3	26	18.6	0.172
19:	16.804	5.2717	16.804	5.2719	30	106	11.9	25	17.9	0.212
20:	17.222	5.1446	17.210	5.1483	34	120	13.5	37	26.4	0.278
21:	17.799	4.9792	17.811	4.9760	31	122	13.7	25	17.9	0.184
22:	18.636	4.7575	18.643	4.7556	18	119	13.4	25	17.9	0.189
23:	19.345	4.5846	19.346	4.5843	15	104	11.7	26	18.6	0.225
24:	19.718	4.4988	19.719	4.4986	14	48	5.4	5	3.6	0.094
25:	20.499	4.3291	20.508	4.3273	15	43	4.8	8	5.7	0.167
26:	20.896	4.2478	20.895	4.2479	18	53	6.0	12	8.6	0.204
27:	21.420	4.1449	21.424	4.1442	21	90	10.1	24	17.1	0.240
28:	22.120	4.0153	22.123	4.0148	26	49	5.5	9	6.4	0.165
29:	22.839	3.8905	22.844	3.8898	27	100	11.3	15	10.7	0.135
30:	23.241	3.8242	23.241	3.8243	27	56	6.3	4	2.9	0.064
31:	23.820	3.7326	23.820	3.7326	26	76	8.6	8	5.7	0.095
32:	24.200	3.6748	24.207	3.6737	25	286	32.2	54	38.6	0.170
33:	24.641	3.6099	24.639	3.6103	25	64	7.2	13	9.3	0.183
34:	25.079	3.5480	25.079	3.5479	24	30	3.4	4	2.9	0.120
35:	25.522	3.4874	25.521	3.4874	31	96	10.8	9	6.4	0.084
36:	25.701	3.4635	25.701	3.4635	36	86	9.7	9	6.4	0.094
37:	25.793	3.4514	25.793	3.4514	39	126	14.2	8	5.7	0.057
38:	26.239	3.3936	26.240	3.3936	37	41	4.6	8	5.7	0.176
39:	26.567	3.3525	26.579	3.3510	36	96	10.8	22	15.7	0.206
40:	26.878	3.3144	26.862	3.3163	28	170	19.1	31	22.1	0.164
41:	27.720	3.2156	27.721	3.2155	40	137	15.4	62	44.3	0.407
42:	27.879	3.1977	27.835	3.2025	39	166	18.7	43	30.7	0.233
43:	29.079	3.0683	29.081	3.0681	34	54	6.1	7	5.0	0.117

#	2Theta	d	2Theta	d	Bkgrd	Peak	I%	Area	I%	FWHM*
44:	29.462	3.0294	29.463	3.0292	32	43	4.8	5	3.6	0.105
45:	29.944	2.9817	29.948	2.9813	30	74	8.3	18	12.9	0.219
[illegible]:	30.077	2.9688	30.073	2.9692	30	40	4.5	17	12.1	0.382
47:	30.843	2.8968	30.841	2.8969	27	82	9.2	16	11.4	0.176
48:	31.519	2.8361	31.520	2.8361	26	46	5.2	7	5.0	0.137
49:	31.980	2.7964	31.980	2.7964	32	50	5.6	3	2.1	0.054
50:	32.075	2.7882	32.068	2.7888	30	36	4.1	5	3.6	0.125
51:	32.639	2.7413	32.641	2.7412	27	61	6.9	10	7.1	0.148
52:	33.084	2.7055	33.082	2.7057	28	44	5.0	12	8.6	0.245
53:	33.565	2.6678	33.568	2.6676	27	70	7.9	8	5.7	0.103
54:	34.041	2.6316	34.041	2.6316	28	19	2.1	2	1.4	0.095
55:	34.398	2.6050	34.403	2.6047	29	42	4.7	9	6.4	0.193
56:	34.808	2.5753	34.808	2.5753	33	34	3.8	3	2.1	0.079
57:	36.060	2.4887	36.061	2.4886	31	66	7.4	14	10.0	0.191
58:	37.179	2.4164	37.180	2.4163	34	95	10.7	23	16.4	0.218
59:	38.260	2.3505	38.260	2.3505	33	51	5.7	4	2.9	0.071
60:	38.361	2.3446	38.353	2.3450	33	42	4.7	6	4.3	0.129
61:	39.040	2.3054	39.038	2.3055	33	44	5.0	4	2.9	0.082
62:	39.413	2.2844	39.413	2.2844	33	31	3.5	2	1.4	0.058
63:	40.145	2.2444	40.145	2.2444	35	30	3.4	2	1.4	0.060
64:	40.561	2.2223	40.563	2.2222	38	73	8.2	16	11.4	0.197
65:	41.341	2.1822	41.342	2.1821	40	50	5.6	8	5.7	0.144
66:	41.439	2.1773	41.442	2.1771	40	66	7.4	18	12.9	0.245
67:	41.938	2.1525	41.938	2.1525	42	58	6.5	2	1.4	0.031
68:	42.439	2.1282	42.435	2.1284	38	46	5.2	5	3.6	0.098
69:	42.886	2.1071	42.889	2.1069	38	55	6.2	5	3.6	0.082
70:	43.280	2.0888	43.285	2.0886	40	36	4.1	8	5.7	0.200
[illegible]:	44.580	2.0309	44.580	2.0309	34	30	3.4	2	1.4	0.060
72:	44.940	2.0154	44.942	2.0153	32	52	5.9	6	4.3	0.104
73:	45.061	2.0103	45.059	2.0104	31	56	6.3	12	8.6	0.193
74:	45.882	1.9762	45.881	1.9763	31	45	5.1	5	3.6	0.100
75:	45.979	1.9723	45.977	1.9724	32	40	4.5	8	5.7	0.180
76:	46.500	1.9514	46.500	1.9514	36	43	4.8	5	3.6	0.105
77:	47.360	1.9179	47.360	1.9179	43	25	2.8	2	1.4	0.072
78:	49.081	1.8546	49.080	1.8547	36	31	3.5	5	3.6	0.145
79:	51.973	1.7580	51.973	1.7580	33	19	2.1	2	1.4	0.095
80:	52.018	1.7566	52.027	1.7563	33	24	2.7	4	2.9	0.150
81:	58.760	1.5701	58.756	1.5702	27	23	2.6	4	2.9	0.157
82:	61.560	1.5052	61.560	1.5052	25	22	2.5	2	1.4	0.082

* Intensity values are based on total raw counts.

URANOPHANE SYNTHESIS

WRITTEN BY: J.D. Prikryl
REVISION NO.: 3

DATE WRITTEN: March 7, 1995
DATE REVISED: Oct 4, 1995

OBJECTIVE: to synthesize uranophane [$Ca(UO_2)_2(SiO_3OH)_2.5H_2O$] for use in thermodynamic experiments of uranyl silicate minerals for the near-field geochemistry project.

EQUIPMENT:
Parr stainless steel reaction vessels (Model 4913EB; 2000 ml capacity)
Teflon liners for reaction vessels
Parr Model 4841 or 4843 temperature controllers
Type J themocouples (teflon coated)
ORION ph/mV/ISE/^{o}C meter
Combination ph electrode
Automatic termperature compensator probe
Analytical balance (Mettler PM 4600)
Welsh vacuum pump (Model 8910)
Hot plate (Thermolyne Type 13100)

SUPPLIES:
pH buffers (pH= 1,2,4)
ultrapure water
glassware and platicware as needed
1000 ml erlenmeyer flasks with stoppers
Fittings, valves, and tubing as necessary

REAGENTS:
Uranyl acetate dihydrate [$UO_2(CH_3COO_2.2H_2O$; MW=424.15 (analysis no. 337419/1 1094)
Silicic acid [$SiO_2.nH_2O$]; MW depends on H_2O content; assume no H_2O; - MW = 60 (lot 951303)
Calcium acetate monohydrate [$Ca(CH_3COO)_2.H_2O$; MW=176.19 (lot 944231)
9 M HCl - diluted from lot 945500

PROCEDURE:

The procedure for uranophane synthesis is based on Cesbron et al., 1993. Reagents will be mixed in the stoichiometric ratio Ca:U:Si = 2:1:1. Although Cesbron et al. do not give information on the amount of solid and H_2O used, they state that good crystallinity is obtained if pH is less than 5.

a) Place 35 g Ca-acetate, 42 g U-acetate, and 6 g silicic acid in a 2000 ml teflon liner and place liner in reaction vessel.

b) Transfer approximately 1500 ml of ultrapure H_2O to a 2000 ml erlenmeyer flask and lower pH of the fluid to 1.0 by dropwise addition of 9M HCl.

c) Degas the H_2O by boiling on a hotplate.

d) Transfer approximately 1300 g of the degassed H_2O to the teflon liner and place in pressure vessel.

e) Raise and set the temperature of the solution in the reaction vessel to 150C using the temperature controller.

f) Degas the pressure vessel once it reaches >140C by opening the air intake valve attached to the pressure gauge assembly.

g) Close intake valve after degassing and allow reagents to react for about 10 days.

URANOPHANE SYNTHESIS

WRITTEN BY: J.D. Prikryl
REVISION NO.: 4

DATE WRITTEN: March 7, 1995
DATE REVISED: April 15, 1996

OBJECTIVE: to synthesize uranophane [$Ca(UO_2)_2(SiO_3OH)_2.5H_2O$] for use in thermodynamic experiments of uranyl silicate minerals for the near-field geochemistry project.

EQUIPMENT:
Parr stainless steel reaction vessels (Model 4913EB; 2000 ml capacity)
Teflon liners for reaction vessels
Parr Model 4841 or 4843 temperature controllers
Type J themocouples (teflon coated)
ORION ph/mV/ISE/^{o}C meter
Combination ph electrode
Automatic termperature compensator probe
Analytical balance (Mettler PM 4600)
Welsh vacuum pump (Model 8910)
Hot plate (Thermolyne Type 13100)

SUPPLIES:
pH buffers (pH= 1,2,4)
ultrapure water
glassware and platicware as needed
1000 ml erlenmeyer flasks with stoppers
Fittings, valves, and tubing as necessary

REAGENTS:
Uranyl acetate dihydrate [$UO_2(CH_3COO_2.2H_2O$; MW=424.15 (analysis no. 337419/1 1094)
Silicic acid [$SiO_2.nH_2O$]; MW depends on H_2O content; assume no H_2O; - MW = 60 (lot 951303)
Calcium acetate monohydrate [$Ca(CH_3COO)_2.H_20$; MW=176.19 (lot 944231)
9 M HCl - diluted from lot 945500

PROCEDURE:

The procedure for uranophane synthesis is based on Cesbron et al., 1993. Reagents will be mixed in the stoichiometric ratio Ca:U:Si = 2:1:1. Although Cesbron et al. do not give information on the amount of solid and H_2O used, they state that good crystallinity is obtained if pH is less than 5.

a) Place 10.2 g Ca-acetate, 12.25 g U-acetate, and 1.75 g silicic acid in a 2000 ml teflon liner and place liner in reaction vessel.

b) Transfer approximately 1500 ml of ultrapure H_2O to a 2000 ml erlenmeyer flask and lower pH of the fluid to 1.0 by dropwise addition of 9M HCl.

c) Degas the H_2O by boiling on a hotplate.

d) Transfer approximately 1350 g of the degassed H_2O to the teflon liner and place in pressure vessel.

e) Raise and set the temperature of the solution in the reaction vessel to 150C using the temperature controller.

f) Degas the pressure vessel once it reaches >110C by opening the air intake valve attached to the pressure gauge assembly.

g) Close intake valve after degassing and allow reagents to react for about 10 days.

========== Southwest Research Institute ==========

Jade: Peak Listing Mon Sep 25 1995 @11:04am

File: URAN6A.MDI> URAN6A * XRD

Scan Parameters:	Search Parameters:
Radiation = CU_1.54059	Filter length(pts) = 25
Scan Range = 2- 70	Noise level(sigmas) = 3.0
Step Size = .02	Intensity cutoff(%) = 1.0-100
Count Time = 2 sec.	2-Theta Zero (degs) = 0

	Peak-Position		Centroid-Position		Peak & Area are without Bkgrd					
#	2Theta	d	2Theta	d	Bkgrd	Peak	I%	Area	I%	FWHM*
1:	11.303	7.8218	11.295	7.8278	41	699	100.0	156	55.7	0.201
2:	13.482	6.5625	13.483	6.5620	70	165	23.6	28	10.0	0.153
3:	14.224	6.2216	14.224	6.2216	83	265	37.9	62	22.1	0.211
4:	14.679	6.0296	14.680	6.0295	66	211	30.2	42	15.0	0.179
5:	15.359	5.7642	15.352	5.7670	68	118	16.9	51	18.2	0.389
6:	15.741	5.6254	15.737	5.6266	57	93	13.3	38	13.6	0.368
7:	16.419	5.3944	16.409	5.3976	100	125	17.9	31	11.1	0.223
8:	18.521	4.7867	18.525	4.7858	33	201	28.8	45	16.1	0.201
9:	19.624	4.5202	19.624	4.5202	32	46	6.6	3	1.1	0.059
10:	20.764	4.2745	20.768	4.2737	27	68	9.7	11	3.9	0.146
11:	22.621	3.9275	22.616	3.9284	24	380	54.4	85	30.4	0.201
12:	24.804	3.5867	24.802	3.5869	26	77	11.0	20	7.1	0.234
13:	25.521	3.4875	25.523	3.4872	31	148	21.2	31	11.1	0.189
14:	26.999	3.2998	27.000	3.2997	68	451	64.5	153	54.6	0.305
15:	27.941	3.1906	27.942	3.1905	48	314	44.9	74	26.4	0.212
16:	28.480	3.1315	28.474	3.1322	74	477	68.2	280	100.0	0.528
17:	29.978	2.9783	29.971	2.9790	60	295	42.2	62	22.1	0.189
18:	30.780	2.9025	30.785	2.9021	52	206	29.5	80	28.6	0.350
19:	31.181	2.8662	31.168	2.8672	49	118	16.9	70	25.0	0.534
20:	31.336	2.8523	31.338	2.8521	48	87	12.4	39	13.9	0.403
21:	33.360	2.6837	33.359	2.6838	38	188	26.9	70	25.0	0.335
22:	33.820	2.6483	33.819	2.6483	35	118	16.9	54	19.3	0.412
23:	34.199	2.6198	34.199	2.6197	34	129	18.5	14	5.0	0.098
24:	35.561	2.5225	35.555	2.5229	30	27	3.9	5	1.8	0.167
25:	37.103	2.4211	37.103	2.4211	21	73	10.4	4	1.4	0.049
26:	37.240	2.4125	37.242	2.4124	20	82	11.7	30	10.7	0.329
27:	37.376	2.4041	37.378	2.4039	23	53	7.6	25	8.9	0.425
28:	39.985	2.2530	39.983	2.2531	12	39	5.6	8	2.9	0.185
29:	40.096	2.2470	40.099	2.2469	12	32	4.6	5	1.8	0.141
30:	41.080	2.1954	41.077	2.1956	19	94	13.4	27	9.6	0.259
31:	43.159	2.0944	43.168	2.0940	22	120	17.2	34	12.1	0.255
32:	46.080	1.9682	46.083	1.9681	36	76	10.9	18	6.4	0.213
33:	46.739	1.9420	46.722	1.9427	43	303	43.3	155	55.4	0.460
34:	48.842	1.8631	48.841	1.8632	42	82	11.7	27	9.6	0.296
35:	49.420	1.8427	49.421	1.8427	34	184	26.3	138	49.3	0.675
36:	49.540	1.8385	49.545	1.8384	42	172	24.6	33	11.8	0.173
37:	49.699	1.8330	49.696	1.8331	40	162	23.2	87	31.1	0.483
38:	52.361	1.7459	52.361	1.7459	31	36	5.2	3	1.1	0.075
39:	54.620	1.6789	54.620	1.6789	42	36	5.2	3	1.1	0.075
40:	55.481	1.6549	55.479	1.6549	46	78	11.2	18	6.4	0.208
41:	55.644	1.6504	55.642	1.6505	47	92	13.2	14	5.0	0.137
42:	56.702	1.6221	56.697	1.6223	49	58	8.3	9	3.2	0.140
43:	56.859	1.6180	56.861	1.6179	49	77	11.0	14	5.0	0.164

#	2Theta	d	2Theta	d	Bkgrd	Peak	I%	Area	I%	FWHM*
44:	57.041	1.6133	57.040	1.6133	49	74	10.6	7	2.5	0.085
45:	57.579	1.5995	57.580	1.5995	47	45	6.4	8	2.9	0.160
[illegible]:	58.779	1.5696	58.779	1.5697	45	53	7.6	4	1.4	0.068
47:	63.858	1.4565	63.866	1.4563	23	32	4.6	7	2.5	0.197
48:	64.718	1.4392	64.718	1.4392	20	42	6.0	3	1.1	0.064
49:	64.917	1.4353	64.917	1.4353	21	39	5.6	3	1.1	0.069
50:	67.720	1.3825	67.725	1.3824	23	31	4.4	5	1.8	0.145
51:	68.399	1.3705	68.399	1.3704	24	44	6.3	6	2.1	0.123

* Intensity values are based on total raw counts.

========== Southwest Research Institute ==========

Jade: Peak Listing Mon Sep 25 1995 @10:27am

File: SODD5A.MDI> SODD5A * XRD

Scan Parameters:	Search Parameters:
Radiation = CU_1.54059	Filter length(pts) = 25
Scan Range = 2- 70	Noise level(sigmas) = 3.0
Step Size = .02	Intensity cutoff(%) = 1.0-100
Count Time = 2 sec.	2-Theta Zero (degs) = 0

	Peak-Position		Centroid-Position		Peak & Area are without Bkgrd					
#	2Theta	d	2Theta	d	Bkgrd	Peak	I%	Area	I%	FWHM*
1:	14.240	6.2147	14.216	6.2252	18	1186	91.8	286	76.9	0.217
2:	17.379	5.0987	17.387	5.0963	43	518	40.1	105	28.2	0.182
3:	18.027	4.9168	18.021	4.9184	28	354	27.4	68	18.3	0.173
4:	18.540	4.7818	18.538	4.7825	19	382	29.6	104	28.0	0.245
5:	19.162	4.6279	19.171	4.6260	31	151	11.7	16	4.3	0.095
6:	19.661	4.5118	19.630	4.5188	25	1292	100.0	333	89.5	0.232
7:	23.128	3.8426	23.126	3.8430	12	136	10.5	41	11.0	0.271
8:	23.619	3.7638	23.603	3.7663	8	208	16.1	55	14.8	0.238
9:	25.944	3.4316	25.949	3.4309	9	53	4.1	4	1.1	0.068
10:	26.841	3.3189	26.814	3.3222	8	1246	96.4	372	100.0	0.269
11:	27.539	3.2364	27.529	3.2375	9	422	32.7	91	24.5	0.194
12:	29.999	2.9763	29.996	2.9766	9	395	30.6	89	23.9	0.203
13:	31.980	2.7963	31.977	2.7965	15	212	16.4	59	15.9	0.250
14:	33.099	2.7043	33.093	2.7047	14	736	57.0	177	47.6	0.216
15:	33.880	2.6437	33.879	2.6438	18	77	6.0	14	3.8	0.164
16:	34.635	2.5878	34.636	2.5877	15	88	6.8	7	1.9	0.072
17:	35.018	2.5604	35.013	2.5607	17	38	2.9	6	1.6	0.142
18:	35.797	2.5064	35.800	2.5062	18	45	3.5	9	2.4	0.180
19:	36.299	2.4729	36.309	2.4722	15	462	35.8	142	38.2	0.277
20:	36.597	2.4534	36.599	2.4533	14	219	17.0	50	13.4	0.205
21:	37.480	2.3977	37.483	2.3975	12	33	2.6	5	1.3	0.136
22:	38.762	2.3212	38.782	2.3201	7	160	12.4	27	7.3	0.152
23:	40.078	2.2480	40.086	2.2476	14	200	15.5	47	12.6	0.211
24:	40.980	2.2006	40.981	2.2005	11	132	10.2	26	7.0	0.177
25:	41.580	2.1702	41.587	2.1698	13	47	3.6	8	2.2	0.153
26:	42.101	2.1445	42.092	2.1450	14	21	1.6	4	1.1	0.171
27:	43.302	2.0878	43.316	2.0871	11	304	23.5	81	21.8	0.240
28:	43.781	2.0661	43.776	2.0663	11	111	8.6	39	10.5	0.316
29:	44.339	2.0413	44.349	2.0409	10	144	11.1	48	12.9	0.300
30:	45.980	1.9723	45.999	1.9715	13	244	18.9	55	14.8	0.203
31:	47.758	1.9029	47.777	1.9022	21	207	16.0	70	18.8	0.304
32:	48.276	1.8836	48.278	1.8836	14	62	4.8	9	2.4	0.131
33:	49.057	1.8555	49.053	1.8556	23	434	33.6	107	28.8	0.222
34:	51.019	1.7886	51.022	1.7886	13	67	5.2	15	4.0	0.201
35:	51.740	1.7654	51.754	1.7650	14	132	10.2	34	9.1	0.232
36:	52.838	1.7313	52.838	1.7313	14	45	3.5	9	2.4	0.180
37:	53.859	1.7008	53.849	1.7011	20	152	11.8	52	14.0	0.308
38:	54.762	1.6749	54.762	1.6749	14	97	7.5	35	9.4	0.325
39:	55.177	1.6633	55.170	1.6635	13	151	11.7	50	13.4	0.298
40:	55.878	1.6441	55.884	1.6439	18	220	17.0	83	22.3	0.340
41:	57.579	1.5995	57.585	1.5993	14	105	8.1	30	8.1	0.257
42:	58.316	1.5810	58.330	1.5807	12	73	5.7	35	9.4	0.432
43:	58.920	1.5662	58.913	1.5664	11	40	3.1	11	3.0	0.247

#	2Theta	d	2Theta	d	Bkgrd	Peak	I%	Area	I%	FWHM*
44:	59.639	1.5491	59.639	1.5490	14	39	3.0	8	2.2	0.185
45:	60.746	1.5235	60.745	1.5235	11	46	3.6	11	3.0	0.215
46:	61.182	1.5136	61.185	1.5136	10	115	8.9	24	6.5	0.188
47:	61.239	1.5124	61.240	1.5123	10	89	6.9	14	3.8	0.142
48:	61.947	1.4968	61.963	1.4964	11	44	3.4	17	4.6	0.348
49:	62.059	1.4943	62.060	1.4943	11	46	3.6	12	3.2	0.235
50:	63.215	1.4698	63.224	1.4696	11	43	3.3	12	3.2	0.251
51:	66.475	1.4054	66.476	1.4054	12	85	6.6	30	8.1	0.318
52:	69.305	1.3547	69.311	1.3546	34	74	5.7	22	5.9	0.268
53:	69.420	1.3528	69.420	1.3528	36	66	5.1	10	2.7	0.136

* Intensity values are based on total raw counts.

SOUTHWEST RESEARCH INSTITUTE

CHAIN OF CUSTODY

DIV. 20
Client

Bill To:

Job No:

Address

Project No: 20-5704-152

City State/Zip

Sampled by:

Facility Name:

Attention Telephone #

Requested Turn Around:
☐ 1 Week ☒ 2 Weeks (Normal) ☐ 3 Weeks ☐ Other:

APPROVED:

SwRI ID	Date Sampled	Time Sampled	Matrix	# of Containers	Pres	pH	Sample Condition	Analyses Requested
20 A			Solid	1			INTACT	URANIUM + ICP
B				1				
C				1				
D				1				
E				1				
F				1				
G				1				
H				1				
I				1				
J				1				

1. Relinquished By: James D Luh	Date/Time: 7/13/95	1. Received By:	Date/Time: 14:25 7-13-95	3. Relinquinshed by:	Date/Time	Sample Location:
2. Relinquished By:	Date/Time:	2. Received By:	Date/Time:	4. Relinquinshed by:	Date/Time	Comments:

SOUTHWEST RESEARCH INSTITUTE

CHAIN OF CUSTODY

Div. 20
Client

Bill To:

Job No:

Address

Project No: 20-5704-152

City State/Zip

Sampled by:

Facility Name:

Attention Telephone #

Requested Turn Around:
☐ 1 Week ☒ 2 Weeks (Normal) ☐ 3 Weeks ☐ Other:

APPROVED:

SwRI ID	Date Sampled	Time Sampled	Matrix	# of Containers	Pres	pH	Sample Condition	Analyses Requested
20 K			Solid	1	–	–	INTACT	Full ICP
L				1	–	–		
M				1	–	–		
N				1	–	–		

1. Relinquished By:	Date/Time:	1. Received By:	Date/Time:	3. Relinquinshed by:	Date/Time
James D. Finley	7/13/95	Joe Moore	1420 7-13-95		
2. Relinquished By:	Date/Time:	2. Received By:	Date/Time:	4. Relinquinshed by:	Date/Time

Sample Location: QC

Comments: Please give accounting of QC and analysis procedures, and results of QC samples.

08-0442: QM:Indexed d:Debye-Scherrer I:Film-Visual Estimate

Uranophane
Ca (H3 O)2 (U O2)2 (Si O4)2 !3 H2 O

Radiation : CuKa Lambda: 1.5418 Filter: Ni
Calibration: d-CutOff: I/Ic(RIR):
Ref: Frondel, Riska, Frondel.
U.S. Geol. Surv. Bull., 1036 142 (1956)

System: Monoclinic(Powder Diffraction) S.G.: P21/a (14) Z= 2
Cell Parameters= 15.870 7.050 6.660 90.00 97.25 90.00 mp=
Ref: Gorman, Nuffield.
Am. Mineral., 40 634 (1955)
Dx= 3.848 Dm= 3.830 Mwt= 856.39 Vol(RC)= 739.19 F(30)=3.3(0.061,146)

ea= 1.642 nwB= 1.666 ey= 1.668 Sign: - 2V= 0°
Ref:

Greenish yellow. Specimen from Ruggles pegmatite, Grafton Center, New Hampshire, USA. Plus 5 lines to 1.239. Deleted by 39-1360.

39 Reflections. Radiation: CU_1.540598. Strong Lines: 7.88/X 3.94/9 2.99/8 2.91/8 1.97/7 4.76/5 3.20/5 2.63/5 2.10/5

#	d(A)	I(fix)	I(var)	h	k	l	2-Theta	Theta	1/(2d)
1>	7.8800	100	35	2	0	0	11.220	5.610	0.06345
2>	6.6100	40	17	0	0	1	13.384	6.692	0.07564
3>	5.4200	40	20	-2	0	1	16.341	8.171	0.09225
4>	4.7600	50	29	2	0	1	18.626	9.313	0.10504
5>	4.2900	20	13	-2	1	1	20.688	10.344	0.11655
6>	3.9400	90	64	4	0	0	22.549	11.274	0.12690
7>	3.6000	40	31	-4	0	1	24.710	12.355	0.13889
8>	3.5100	40	32	0	2	0	25.354	12.677	0.14245
9>	3.4100	10	8	3	1	1	26.111	13.055	0.14663
10>	3.3500	10	8	0	0	2	26.587	13.294	0.14925
11>	3.2000	50	44	-4	1	1	27.858	13.929	0.15625
12>	3.0900	10	9	-1	2	1	28.871	14.435	0.16181
13>	2.9900	80	75	0	1	2	29.858	14.929	0.16722
14>	2.9100	80	77	-2	1	2	30.699	15.350	0.17182
15>	2.6900	40	41	2	1	2	33.280	16.640	0.18587
16>	2.6300	50	53	4	2	0	34.062	17.031	0.19011
17>	2.5700	20	21	-6	0	1	34.882	17.441	0.19455
18>	2.5200	20	22	-4	1	2	35.597	17.799	0.19841
19>	2.4000	10	11	-6	1	1	37.442	18.721	0.20833
20>	2.2600	20	25	4	1	2	39.856	19.928	0.22124
21>	2.2000	40	51	0	0	3	40.991	20.496	0.22727
22>	2.1000	50	67	0	1	3	43.038	21.519	0.23810
23>	2.0600	20	27	2	0	3	43.917	21.958	0.24272
24>	1.9690	70	100	7	1	1	46.060	23.030	0.25394
25>	1.9060	20	29	-7	1	2	47.675	23.838	0.26233
26>	1.8890	10	15	-2	3	2	48.131	24.066	0.26469
27>	1.8670	30	45	0	2	3	48.735	24.367	0.26781
28>	1.8270	10	15	4	0	3	49.874	24.937	0.27367
29>	1.7690	30	47	4	1	3	51.627	25.813	0.28265
30>	1.7470	30	48	-6	1	3	52.326	26.163	0.28620
31>	1.7170	10	16	8	2	0	53.312	26.656	0.29121
32>	1.6590	20	34	-2	0	4	55.332	27.666	0.30139
33>	1.6010	10	17	-6	3	2	57.519	28.760	0.31230
34>	1.5790	20	35	-3	3	3	58.397	29.199	0.31666
35>	1.5370	20	36	-10	1	0	60.155	30.077	0.32531
36>	1.4960	20	37	0	2	4	61.982	30.991	0.33422
37>	1.4610	20	38	8	2	2	63.638	31.819	0.34223
38>	1.4420	20	39	4	3	3	64.578	32.289	0.34674
39>	1.3820	10	20	8	0	3	67.750	33.875	0.36179

========== Southwest Research Institute ==========

Jade: Peak Listing Wed Jun 14 1995 @7:58am

File: 2NFY3.MDI> 6/14/95 - 2NFY3-XRD

Scan Parameters:	Search Parameters:
Radiation = CU_1.54059	Filter length(pts) = 25
Scan Range = 2- 70	Noise level(sigmas) = 3.0
Step Size = .02	Intensity cutoff(%) = 1.0-100
Count Time = 2 sec.	2-Theta Zero (degs) = 0

	Peak-Position		Centroid-Position		Peak & Area are without Bkgrd					
#	2Theta	d	2Theta	d	Bkgrd	Peak	I%	Area	I%	FWHM*
1:	11.399	7.7564	11.373	7.7744	30	1269	100.0	368	100.0	0.261
2:	13.580	6.5151	13.557	6.5264	29	300	23.6	73	19.8	0.219
3:	16.500	5.3683	16.495	5.3698	24	285	22.5	90	24.5	0.284
4:	18.621	4.7614	18.628	4.7594	21	541	42.6	168	45.7	0.279
5:	20.861	4.2549	20.864	4.2541	22	124	9.8	36	9.8	0.261
6:	22.720	3.9106	22.711	3.9122	20	777	61.2	219	59.5	0.254
7:	24.900	3.5731	24.900	3.5730	20	202	15.9	56	15.2	0.250
8:	25.637	3.4719	25.642	3.4713	21	451	35.5	113	30.7	0.225
9:	27.037	3.2953	27.032	3.2959	31	40	3.2	7	1.9	0.157
10:	28.024	3.1814	28.040	3.1797	30	567	44.7	140	38.0	0.222
11:	29.043	3.0720	29.041	3.0723	38	48	3.8	7	1.9	0.131
12:	30.042	2.9721	30.053	2.9711	37	591	46.6	153	41.6	0.233
13:	30.859	2.8953	30.855	2.8957	38	379	29.9	111	30.2	0.264
14:	31.822	2.8098	31.821	2.8099	40	56	4.4	5	1.4	0.080
15:	33.440	2.6775	33.429	2.6783	32	182	14.3	57	15.5	0.282
16:	34.300	2.6123	34.302	2.6122	28	178	14.0	44	12.0	0.222
17:	35.244	2.5444	35.242	2.5446	24	44	3.5	8	2.2	0.164
18:	35.621	2.5184	35.626	2.5181	21	80	6.3	22	6.0	0.247
19:	35.696	2.5133	35.709	2.5124	21	71	5.6	31	8.4	0.393
20:	35.958	2.4956	35.958	2.4955	19	63	5.0	6	1.6	0.086
21:	37.600	2.3902	37.599	2.3903	12	38	3.0	7	1.9	0.166
22:	40.098	2.2469	40.098	2.2469	23	70	5.5	5	1.4	0.064
23:	41.159	2.1914	41.161	2.1913	22	197	15.5	70	19.0	0.320
24:	42.302	2.1348	42.299	2.1350	27	36	2.8	4	1.1	0.100
25:	43.241	2.0906	43.244	2.0905	24	243	19.1	80	21.7	0.296
26:	44.081	2.0527	44.081	2.0527	22	59	4.6	25	6.8	0.381
27:	44.218	2.0467	44.199	2.0475	22	80	6.3	25	6.8	0.281
28:	46.199	1.9634	46.203	1.9632	23	113	8.9	29	7.9	0.231
29:	46.460	1.9530	46.463	1.9529	23	134	10.6	14	3.8	0.094
30:	47.838	1.8999	47.847	1.8995	27	147	11.6	50	13.6	0.306
31:	48.359	1.8806	48.361	1.8806	28	104	8.2	85	23.1	0.736
32:	48.880	1.8618	48.879	1.8618	29	120	9.5	48	13.0	0.360
33:	50.118	1.8187	50.130	1.8182	30	49	3.9	13	3.5	0.239
34:	51.800	1.7635	51.800	1.7635	38	67	5.3	16	4.3	0.215
35:	51.838	1.7623	51.835	1.7624	38	93	7.3	13	3.5	0.126
36:	52.398	1.7448	52.402	1.7446	33	90	7.1	26	7.1	0.260
37:	52.599	1.7386	52.600	1.7385	33	88	6.9	37	10.1	0.378
38:	52.679	1.7361	52.676	1.7362	34	78	6.1	25	6.8	0.288
39:	53.646	1.7071	53.642	1.7072	42	40	3.2	15	4.1	0.337
40:	53.761	1.7037	53.759	1.7038	40	41	3.2	4	1.1	0.088
41:	55.300	1.6599	55.300	1.6599	30	36	2.8	8	2.2	0.200
42:	55.560	1.6527	55.558	1.6528	29	62	4.9	32	8.7	0.465
43:	55.679	1.6495	55.675	1.6496	28	64	5.0	22	6.0	0.309

#	2Theta	d	2Theta	d	Bkgrd	Peak	I%	Area	I%	FWHM*
44:	57.642	1.5979	57.643	1.5979	27	61	4.8	15	4.1	0.221
45:	57.739	1.5954	57.726	1.5958	27	62	4.9	21	5.7	0.305
46:	58.659	1.5726	58.655	1.5727	32	56	4.4	18	4.9	0.289
47:	60.423	1.5308	60.419	1.5309	24	45	3.5	11	3.0	0.220
48:	62.100	1.4934	62.104	1.4934	23	51	4.0	17	4.6	0.300
49:	62.299	1.4891	62.289	1.4894	23	49	3.9	25	6.8	0.459
50:	62.481	1.4853	62.480	1.4853	23	48	3.8	7	1.9	0.131
51:	63.900	1.4556	63.900	1.4556	23	56	4.4	10	2.7	0.161
52:	64.020	1.4532	64.020	1.4532	24	54	4.3	12	3.3	0.200
53:	64.918	1.4353	64.922	1.4352	20	81	6.4	32	8.7	0.356
54:	64.980	1.4340	64.980	1.4340	20	66	5.2	26	7.1	0.355

* Intensity values are based on total raw counts.

URANOPHANE SYNTHESIS

WRITTEN BY: J.D. Prikryl
REVISION NO.: 1

DATE WRITTEN: March 7, 1995
DATE REVISED: June 26, 1995

OBJECTIVE: to synthesize uranophane [$Ca(UO_2)_2(SiO_3OH)_2.5H_2O$] for use in thermodynamic experiments of uranyl silicate minerals for the near-field geochemistry project.

EQUIPMENT:
Parr stainless steel reaction vessels (Model 4913EB; 2000 ml capacity)
Teflon liners for reaction vessels
Parr Model 4841 or 4843 temperature controllers
Type J themocouples (teflon coated)
ORION ph/mV/ISE/^{o}C meter
Combination ph electrode
Automatic termperature compensator probe
Analytical balance (Mettler PM 4600)
Welsh vacuum pump (Model 8910)
Hot plate (Thermolyne Type 13100)

SUPPLIES:
pH buffers (pH= 1,2,4)
ultrapure water
glassware and platicware as needed
1000 ml erlenmeyer flasks with stoppers
Fittings, valves, and tubing as necessary

REAGENTS:
Uranyl acetate dihydrate [$UO_2(CH_3COO_2.2H_2O$; MW=424.15 (lot 944231)
Sodium metasilicate nonahydrate [$Na_2SiO_3.9H_2O$; MW=284.20 (lot 942853A)
Calcium acetate monohydrate [$Ca(CH_3COO)_2.H_20$; MW=176.19
(lot 319617/1 194)
9 M HCl - diluted from lot 945500

PROCEDURE:

The procedure for uranophane synthesis is based on Cesbron et al., 1993. Reagents will be mixed in the stoichiometric ratio Ca:U:Si = 2:1:1. Although Cesbron et al. do not give information on the amount of solid and H_2O used, they state that good crystallinity is obtained if pH is less than 5.

a) Place 35 g Ca-acetate, 42 g U-acetate, and 28 g Na-metasilicate in a 2000 ml teflon liner and place liner in reaction vessel.

b) Cap and seal vessel and evacuate using a vacuum pump to remove $CO_2(g)$.

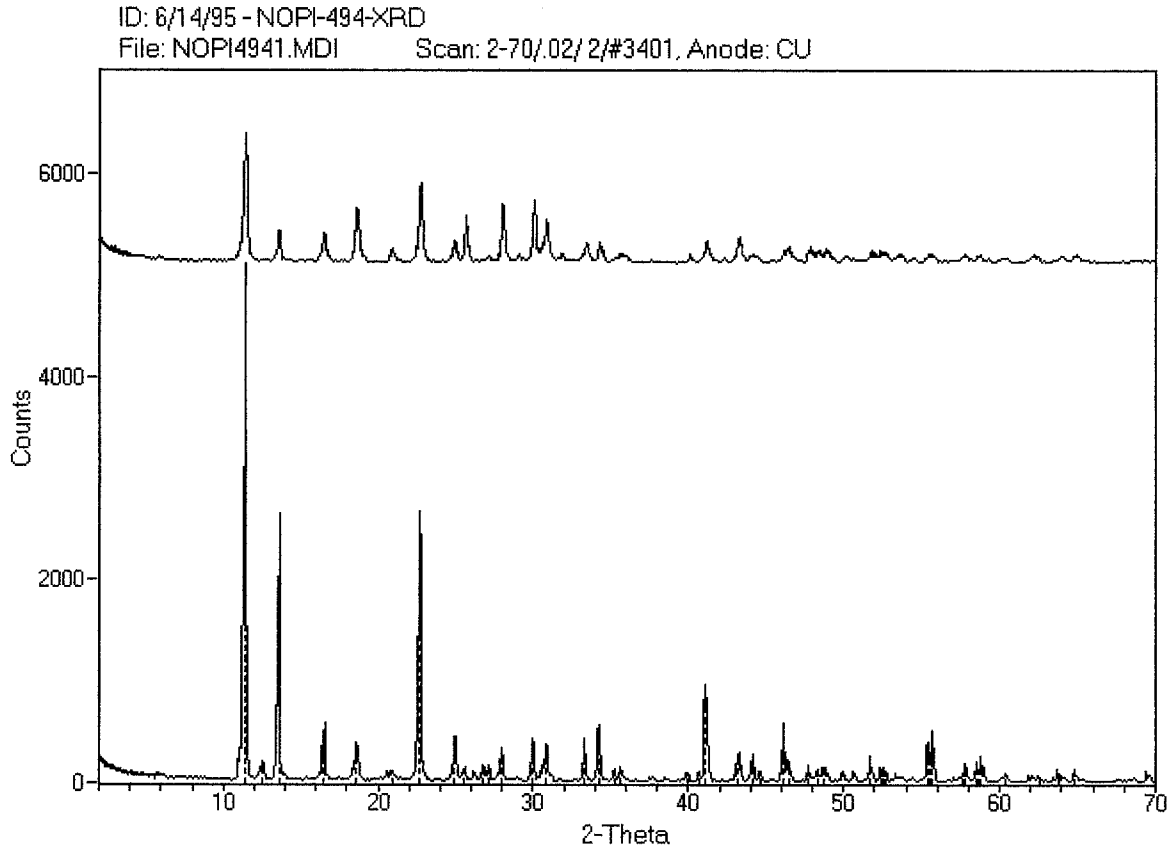
c) Transfer approximately 2000 ml of ultrapure H_2O to a 2000 ml erlenmeyer flask and lower pH of the fluid to 1.0 by dropwise addition of 9M HCl.

d) Degas the H_2O at a pH of 1.0 by boiling on a hotplate. After degassing cap erlenmeyer flask with a rubber stopper so that air cannot enter the flask.

e) After cooling record weight of the erlenmeyer flask with the degassed H_2O.

f) Transfer approximately 1300 g of the degassed H_2O into the vessel by pulling in by vacuum. After the transfer, record weight of the erlenmeyer flask with remaining degassed H_2O to determine actual weight of H_2O introduced.

g) Raise and set the temperature of the solution in the reaction vessel to 150C using the temperature controller and allow the reaction to proceed for one week or longer.



Southwest Research Institute

========== Southwest Research Institute ==========

Jade: Peak Listing Sat Jun 03 1995 @2:41pm

File: 2NFY2.MDI> 6/5/95 - 2NFY2-XRD

Scan Parameters:	Search Parameters:
Radiation = CU_1.54059	Filter length(pts) = 25
Scan Range = 2- 70	Noise level(sigmas) = 3.0
Step Size = .02	Intensity cutoff(%) = 1.0-100
Count Time = 2 sec.	2-Theta Zero (degs) = 0

	Peak-Position		Centroid-Position		Peak & Area are without Bkgrd					
#	2Theta	d	2Theta	d	Bkgrd	Peak	I%	Area	I%	FWHM*
1:	11.202	7.8927	11.182	7.9064	38	2264	100.0	533	100.0	0.212
2:	13.380	6.6121	13.368	6.6182	38	484	21.4	112	21.0	0.208
3:	16.301	5.4333	16.303	5.4326	38	448	19.8	121	22.7	0.243
4:	18.458	4.8029	18.454	4.8039	31	833	36.8	217	40.7	0.234
5:	20.680	4.2917	20.683	4.2909	36	211	9.3	44	8.3	0.188
6:	22.540	3.9415	22.528	3.9435	30	1393	61.5	330	61.9	0.213
7:	24.701	3.6014	24.709	3.6002	26	343	15.2	91	17.1	0.239
8:	25.437	3.4988	25.457	3.4961	27	593	26.2	146	27.4	0.222
9:	26.059	3.4166	26.057	3.4169	28	35	1.5	6	1.1	0.154
10:	26.839	3.3192	26.841	3.3189	34	72	3.2	17	3.2	0.212
11:	27.860	3.1998	27.857	3.2001	35	844	37.3	182	34.1	0.194
12:	28.838	3.0934	28.838	3.0934	47	89	3.9	12	2.3	0.121
13:	29.861	2.9898	29.868	2.9891	41	927	40.9	213	40.0	0.207
14:	30.662	2.9135	30.658	2.9138	42	646	28.5	176	33.0	0.245
15:	31.662	2.8237	31.665	2.8234	44	78	3.4	11	2.1	0.127
16:	33.240	2.6931	33.241	2.6931	41	346	15.3	87	16.3	0.226
17:	34.120	2.6257	34.133	2.6247	37	280	12.4	73	13.7	0.235
18:	35.039	2.5589	35.046	2.5583	33	76	3.4	14	2.6	0.166
19:	35.441	2.5308	35.440	2.5308	29	148	6.5	26	4.9	0.158
20:	37.400	2.4026	37.406	2.4022	15	49	2.2	14	2.6	0.257
21:	39.919	2.2566	39.919	2.2566	25	104	4.6	27	5.1	0.234
22:	40.940	2.2026	40.958	2.2017	23	322	14.2	107	20.1	0.299
23:	43.079	2.0981	43.061	2.0989	28	398	17.6	121	22.7	0.274
24:	44.002	2.0562	44.007	2.0560	27	101	4.5	44	8.3	0.392
25:	44.078	2.0528	44.062	2.0535	27	113	5.0	47	8.8	0.374
26:	45.982	1.9722	46.018	1.9707	24	207	9.1	56	10.5	0.243
27:	46.318	1.9586	46.317	1.9587	24	225	9.9	61	11.4	0.244
28:	47.622	1.9080	47.627	1.9078	26	227	10.0	51	9.6	0.202
29:	48.239	1.8850	48.237	1.8851	29	146	6.4	52	9.8	0.321
30:	48.780	1.8654	48.769	1.8658	32	187	8.3	76	14.3	0.366
31:	49.999	1.8227	49.992	1.8229	35	84	3.7	23	4.3	0.246
32:	51.661	1.7679	51.661	1.7679	50	100	4.4	30	5.6	0.270
33:	51.741	1.7654	51.740	1.7654	51	122	5.4	24	4.5	0.177
34:	52.260	1.7490	52.263	1.7490	40	120	5.3	42	7.9	0.315
35:	53.478	1.7121	53.479	1.7120	51	63	2.8	10	1.9	0.143
36:	53.618	1.7079	53.618	1.7079	48	64	2.8	7	1.3	0.098
37:	55.163	1.6637	55.162	1.6637	30	83	3.7	13	2.4	0.141
38:	55.559	1.6528	55.559	1.6527	30	93	4.1	14	2.6	0.135
39:	57.461	1.6025	57.460	1.6025	30	90	4.0	19	3.6	0.190
40:	57.541	1.6004	57.541	1.6005	29	85	3.8	10	1.9	0.106
41:	58.420	1.5784	58.420	1.5784	26	106	4.7	13	2.4	0.110
42:	58.999	1.5643	58.999	1.5643	29	59	2.6	6	1.1	0.092
43:	60.081	1.5387	60.080	1.5387	23	79	3.5	9	1.7	0.103

#	2Theta	d	2Theta	d	Bkgrd	Peak	I%	Area	I%	FWHM*
44:	60.157	1.5370	60.156	1.5370	23	84	3.7	26	4.9	0.279
45:	61.686	1.5025	61.694	1.5023	24	64	2.8	6	1.1	0.084
46:	62.061	1.4943	62.071	1.4941	24	72	3.2	40	7.5	0.500
47:	62.220	1.4908	62.220	1.4908	25	87	3.8	10	1.9	0.103
48:	63.841	1.4569	63.841	1.4569	25	95	4.2	32	6.0	0.303
49:	64.722	1.4391	64.725	1.4391	23	89	3.9	46	8.6	0.465
50:	64.775	1.4381	64.769	1.4382	23	106	4.7	8	1.5	0.068
51:	68.382	1.3708	68.381	1.3708	34	46	2.0	6	1.1	0.117

* Intensity values are based on total raw counts.

2NFY.MDI> 5/30/95 - 2NFY-XRD

	Hits Sorted on Figure-Of-Merit	QM*	PDF-#	FOM	I%	OFF	RIR	Space-Group	a	b	c	Vol*	Z	Dx*
1>	Uranophane - Ca(UO2)2(SiO3OH)2!5	+	39-1360	2.3	49	0.00		P21 (4)	15.92	7.01	6.67	739	2	3.849
2>	Hillebrandite - Ca2(SiO3)(OH)2	+	42- 538	19.5	32	0.12		A*a* (63)	11.84	16.32	3.64	352	6	2.693
3>	Hydroxyapophyllite - KCa4Si8O20(	+	29- 994	20.7	53	0.06		P4/mnc (128)	8.98	8.98	15.83	1276	2	2.356
4>	Tilleyite - Ca5Si2O7(CO3)2	+	24- 184	21.7	21	-.06		P21/n (14)	15.02	10.24	7.58	1132	4	2.867
5>	Urancalcarite - Ca(UO2)3CO3(OH)6	+	38- 350	28.4	38	0.00		Pbn* (62)	15.42	16.08	6.97	1728	4	4.098
6>	Scawtite - Ca7(Si6O18)(CO3)!2H2O		31- 261	28.9	46	0.18		I2/m (12)	10.12	15.18	6.62	500	2	2.766
7>	Hydroxyapophyllite - KCa4Si8O20(	+	30- 920	33.3	73	-.18	0.8	P4/mnc (128)	8.98	8.98	15.83	1276	2	2.356
8>	Wollastonite-2\ITM\RG - CaSiO3	+	27- 88	34.2	47	-.18		P21/a (14)	15.43	7.32	7.07	794	12	2.914
9>	Moissanite-3\ITC\RG, syn - SiC	+	29-1129	34.3	4	0.18		F-43m (216)	4.36	4.36	4.36	21	4	3.216
10>	Fairchildite, syn - K2Ca(CO3)2	+	21-1287	37.1	18	-.06	1.5	P63/mmc (194)	5.29	5.29	13.35	324	2	2.441
11>	Nahcolite, syn - NaHCO3	+	15- 700	38.2	20	0.06	0.3	P21/n (14)	7.47	9.69	3.48	252	4	2.218
12>	Pectolite-1\ITA\RG - NaCa2HSi3O9	+	33-1223	39.4	28	-.18	2.8	P-1 (2)	7.03	8.00	7.03	384	2	2.872
13>	Spurrite - Ca5(SiO4)2CO3	+	13- 496	39.8	16	0.00		P21/c (14)	14.15	6.70	10.49	976	4	3.026
14>	Riversideite-9A - Ca5Si6O16(OH)2		29- 329	40.8	51	0.18		P ()	5.57	18.79	3.64	381	1	2.871
15>	Grumantite - NaSi2O4(OH)!H2O		42-1331	40.8	31	0.00		F ()	16.00	18.24	7.18	524	16	2.259
16>	Unnamed mineral [NR] - UO3-H2O	?	15- 569	40.9	84	-.12								
17>	Gaylussite - Na2Ca(CO3)2!5H2O	+	21- 343	41.8	28	0.06	0.4	I*/a (15)	11.58	7.78	11.21	494	4	1.993
18>	Natrosilite, syn - Na2Si2O5	+	23- 529	42.1	48	0.00		P21/a (14)	12.33	4.85	8.13	471	4	2.568
19>	Natrofairchildite - Na2Ca(CO3)2	?	25- 804	42.7	23	-.18		P63/mmc (194)	5.29	5.29	13.22	320	2	2.136
20>	Sodiumboltwoodite - (Na,K)(H3O)U		29-1044	43.4	8	-.06		P212121 (19)	7.02	27.40	6.65	1279	8	4.100
21>	Hoelite, syn - C6H4(CO)2C6H4	+	28-2002	44.7	35	0.00		P21/a (14)	15.81	3.97	7.88	482	2	1.435
22>	Uranophane-$GB - Ca(UO2)2(SiO3OH	+	8- 301	44.9	31	-.06		P21/a (14)	14.01	15.55	6.64	1446	4	3.933
23>	Wollastonite-2\ITM\RG - CaSiO3	+	43-1460	45.5	27	-.12		P21/a (14)	15.43	7.32	7.07	795	12	2.910
24>	Unnamed mineral [NR] - K-Ca-CO3	?	25- 627	47.8	23	0.00								
25>	Killalaite - 2Ca3Si2O7!H2O		26-1070	49.5	21	0.18		P21/m (11)	6.81	15.46	6.81	710	2	2.782
26>	Rustumite - Ca10(Si2O7)2(SiO4)Cl	+	29- 314	49.8	21	0.18	0.8	A2/a (15)	15.50	18.55	7.62	1062	4	2.921
27>	Moissanite-15\ITR\RG, syn - SiC	+	39-1196	50.6	5	0.00		R3m (160)	3.07	3.07	37.70	103	15	3.239
28>	Wollastonite-1\ITA\RG - CaSiO3	+	42- 547	51.4	33	-.18	1.0	P-1 (2)	7.30	7.90	7.05	394	6	2.937
29>	Boltwoodite - K(H3O)(UO2)(SiO4)	+	35- 490	60.1	13	0.18		P21 (4)	7.07	7.06	6.64	319	2	4.372
30>	Rustumite - Ca10(Si2O7)2SiO4Cl2(	+	18- 305	61.9	17	0.18		A2/a (15)	15.50	18.55	7.62	1062	4	2.921
31>	Ianthinite - U6O7(OH)2O		12- 272	63.2	41	0.18		C ()	11.52	30.30	7.15	1248	4	5.004
32>	Hydrohalite - NaCl!2H2O	?	29-1197	65.7	33	-.12		P21/a (14)	6.50	10.12	6.33	379	4	1.654
	Joliotite - (UO2)CO3!2H2O		29-1378	66.6	48	0.06		P*** (47)	8.16	10.35	6.32	534	4	4.555
	Wollastonite-1\ITA\RG - CaSiO3		29- 372	68.1	40	-.18		P1 (1)	7.37	7.89	7.04	397	6	2.913
35>	Flagstaffite, syn - CH3(OH)C6H9C		28-2014	68.9	46	0.18		Fdd2 (43)	18.50	22.60	11.00	1150	16	1.099
36>	Trona - Na3H(CO3)2!2H2O	+	29-1447	68.9	13	0.18	1.0	I2/a (15)	20.11	3.49	10.33	353	4	2.124
37>	Wollastonite-1\ITA\RG - CaSiO3	+	42- 550	71.6	27	-.18	0.9	P-1 (2)	7.31	7.91	7.06	396	6	2.925
38>	Rankinite - Ca3Si2O7	+	22- 539	74.0	5	0.06		P21/n (14)	9.54	8.91	7.85	643	4	2.979
39>	Compreignacite - K2(UO2)6O4(OH)6	+	17- 167	76.3	20	0.00		Pmnn (58)	12.14	14.88	7.16	1293	2	5.157
40>	Rutherfordine - UO2CO3		11- 263	79.1	15	0.00		Pmmn (59)	4.85	9.24	4.33	194	2	5.657

* QM - ? for Doubtful Quality or Non-ambient patterns; + for Indexed patterns with Space-Group, Unit Cell & Density.
* vol - reduced-cell volume; dx - measured density if calculated is not available.

Current S/M parameters:

PDF Subfile to Search ..... MINERALS
Chemistry Filter ..... NF,CHM (Yes)
Search Focus on ..... Major Phase(s)
Preferred Orientation in Sample ..... No
Search only High Quality Phases ..... No
Exclude Questionable Phases ..... No

2-Theta Error Window ..... .18
Sensitivity to Matching Intensity 5
Sensitivity to Matching 2-Theta 5
Maximum Number of Hits to Save 40
Rubber-Ruler Search - %Elasticity 0
Required 100% Line in Srched Range ... No

========== Southwest Research Institute ==========

Jade: Peak Listing — Tue May 30 1995 @3:52pm

File: 2NFY.MDI> 5/30/95 - 2NFY-XRD

Scan Parameters:	Search Parameters:
Radiation = CU_1.54059	Filter length(pts) = 25
Scan Range = 2- 70	Noise level(sigmas) = 3.0
Step Size = .02	Intensity cutoff(%) = 1.0-100
Count Time = 2 sec.	2-Theta Zero (degs) = 0

	Peak-Position		Centroid-Position		Peak & Area are without Bkgrd					
#	2Theta	d	2Theta	d	Bkgrd	Peak	I%	Area	I%	FWHM*
1:	11.080	7.9787	11.075	7.9823	44	1283	100.0	428	100.0	0.300
2:	13.258	6.6726	13.249	6.6771	45	336	26.2	86	20.1	0.230
3:	16.200	5.4669	16.201	5.4665	38	283	22.1	102	23.8	0.324
4:	18.358	4.8289	18.344	4.8324	34	634	49.4	194	45.3	0.275
5:	20.620	4.3040	20.620	4.3040	36	150	11.7	21	4.9	0.126
6:	22.421	3.9622	22.420	3.9623	34	803	62.6	270	63.1	0.303
7:	24.639	3.6102	24.623	3.6126	29	216	16.8	76	17.8	0.317
8:	25.321	3.5146	25.336	3.5125	33	537	41.9	152	35.5	0.255
9:	26.740	3.3312	26.741	3.3310	40	53	4.1	6	1.4	0.102
10:	27.742	3.2132	27.750	3.2122	42	594	46.3	179	41.8	0.271
11:	28.724	3.1055	28.726	3.1052	46	97	7.6	15	3.5	0.139
12:	29.761	2.9996	29.768	2.9989	48	701	54.6	190	44.4	0.244
13:	30.560	2.9229	30.554	2.9235	51	428	33.4	148	34.6	0.311
14:	31.516	2.8364	31.517	2.8363	54	51	4.0	5	1.2	0.088
15:	33.139	2.7011	33.136	2.7013	52	212	16.5	63	14.7	0.267
16:	34.019	2.6332	34.025	2.6328	46	172	13.4	53	12.4	0.277
17:	34.961	2.5644	34.962	2.5643	39	43	3.4	10	2.3	0.209
18:	35.360	2.5364	35.360	2.5364	35	100	7.8	22	5.1	0.198
19:	35.700	2.5130	35.700	2.5130	32	62	4.8	7	1.6	0.102
20:	37.280	2.4100	37.285	2.4097	21	37	2.9	5	1.2	0.122
21:	39.820	2.2620	39.821	2.2619	33	65	5.1	13	3.0	0.180
22:	40.860	2.2068	40.875	2.2060	31	235	18.3	88	20.6	0.337
23:	42.960	2.1036	42.965	2.1034	37	269	21.0	97	22.7	0.325
24:	43.881	2.0616	43.881	2.0616	37	69	5.4	16	3.7	0.209
25:	44.013	2.0557	44.014	2.0557	37	66	5.1	21	4.9	0.286
26:	45.883	1.9762	45.882	1.9762	39	137	10.7	22	5.1	0.145
27:	45.999	1.9715	46.000	1.9714	39	135	10.5	57	13.3	0.380
28:	46.141	1.9657	46.141	1.9658	40	154	12.0	66	15.4	0.386
29:	46.239	1.9618	46.240	1.9618	40	121	9.4	41	9.6	0.305
30:	47.559	1.9104	47.567	1.9101	42	151	11.8	57	13.3	0.340
31:	48.120	1.8894	48.120	1.8894	41	155	12.1	22	5.1	0.128
32:	48.622	1.8711	48.627	1.8709	41	140	10.9	65	15.2	0.418
33:	48.658	1.8698	48.654	1.8699	41	132	10.3	63	14.7	0.430
34:	49.843	1.8280	49.844	1.8280	42	51	4.0	10	2.3	0.176
35:	49.980	1.8234	49.980	1.8234	43	54	4.2	5	1.2	0.083
36:	51.542	1.7717	51.545	1.7716	57	80	6.2	6	1.4	0.067
37:	51.600	1.7699	51.601	1.7698	58	94	7.3	10	2.3	0.096
38:	52.141	1.7528	52.143	1.7527	46	99	7.7	38	8.9	0.345
39:	52.340	1.7466	52.339	1.7466	47	85	6.6	41	9.6	0.434
40:	52.439	1.7435	52.433	1.7437	47	100	7.8	26	6.1	0.234
41:	55.021	1.6676	55.021	1.6676	39	52	4.1	6	1.4	0.104
42:	55.138	1.6644	55.138	1.6644	39	65	5.1	21	4.9	0.291
43:	55.518	1.6539	55.519	1.6539	39	52	4.1	6	1.4	0.104

#	2Theta	d	2Theta	d	Bkgrd	Peak	I%	Area	I%	FWHM*
44:	57.303	1.6065	57.301	1.6066	38	52	4.1	11	2.6	0.190
45:	58.318	1.5810	58.334	1.5806	34	59	4.6	36	8.4	0.549
[illegible]:	58.458	1.5775	58.459	1.5775	37	60	4.7	20	4.7	0.300
47:	60.068	1.5390	60.078	1.5388	30	48	3.7	5	1.2	0.094
48:	60.160	1.5369	60.160	1.5369	30	40	3.1	7	1.6	0.157
49:	61.600	1.5044	61.600	1.5044	32	40	3.1	5	1.2	0.112
50:	61.903	1.4977	61.904	1.4977	33	70	5.5	17	4.0	0.219
51:	62.099	1.4935	62.096	1.4935	33	48	3.7	16	3.7	0.300
52:	63.602	1.4618	63.601	1.4618	29	56	4.4	10	2.3	0.161
53:	63.698	1.4598	63.700	1.4597	30	59	4.6	20	4.7	0.305
54:	64.562	1.4423	64.561	1.4423	24	69	5.4	34	7.9	0.443
55:	64.619	1.4412	64.620	1.4412	24	88	6.9	9	2.1	0.092

* Intensity values are based on total raw counts.

NFGY.MDI> 5/30/95 - NFGY-XRD

	Hits Sorted on Figure-Of-Merit	QM*	PDF-#	FOM	I%	OFF	RIR	Space-Group	a	b	c	Vol*	Z	Dx*
1>	Uranophane - Ca(UO2)2(SiO3OH)2!5	+	39-1360	5.6	65	0.12		P21 (4)	15.92	7.01	6.67	739	2	3.849
2>	Metahaiweeite - CaO!2UO3!6SiO2!x		12- 722	6.2	35	-.06								
3>	Weeksite - K2(UO2)2(Si6O15)!4H2O		12- 462	8.3	30	0.12		Pnna (52)	14.26	35.88	14.20	7265	16	4.018
4>	Boltwoodite - K(H3O)(UO2)(SiO4)	+	35- 490	8.7	80	0.06		P21 (4)	7.07	7.06	6.64	319	2	4.372
5>	Hillebrandite - Ca2(SiO3)(OH)2	+	42- 538	9.8	33	0.06		A*a* (63)	11.84	16.32	3.64	352	6	2.693
6>	Hydroxyapophyllite - KCa4Si8O20(	+	29- 994	12.2	41	0.18		P4/mnc (128)	8.98	8.98	15.83	1276	2	2.356
7>	Tilleyite - Ca5Si2O7(CO3)2	+	24- 184	12.6	24	0.12		P21/n (14)	15.02	10.24	7.58	1132	4	2.867
8>	Hoelite, syn - C6H4(CO)2C6H4	+	28-2002	12.7	20	0.00		P21/a (14)	15.81	3.97	7.88	482	2	1.435
9>	Graphite-2\ITH\RG - C	+	41-1487	13.3	20	0.00	7.8	P63/mmc (194)	2.47	2.47	6.72	36	4	2.245
10>	Nahcolite, syn - NaHCO3	+	15- 700	13.4	45	0.12	0.3	P21/n (14)	7.47	9.69	3.48	252	4	2.218
11>	Whewellite, syn - C2CaO4!H2O	+	20- 231	13.7	24	-.12		P21/n (14)	9.98	7.29	6.29	438	4	2.217
12>	Wollastonite-2\ITM\RG - CaSiO3	+	27- 88	14.0	36	-.12		P21/a (14)	15.43	7.32	7.07	794	12	2.914
13>	Natrofairchildite - Na2Ca(CO3)2	?	25- 804	14.3	24	0.00		P63/mmc (194)	5.29	5.29	13.22	320	2	2.136
14>	Hydroxyapophyllite - KCa4Si8O20(	+	30- 920	14.5	63	0.00	0.8	P4/mnc (128)	8.98	8.98	15.83	1276	2	2.356
15>	Unnamed mineral [NR] - UO3-H2O	?	15- 569	14.8	57	0.18								
16>	Rosenhahnite - Ca3(Si3O8(OH)2)	+	29- 378	15.3	37	-.12		P-1 (2)	6.95	9.48	6.81	420	2	2.899
17>	Studtite, syn - UO4!4H2O	+	16- 206	15.4	26	-.18		C*/* (12)	11.85	6.78	4.24	170	2	3.647
18>	Natrite - Na2CO3		37- 451	16.0	42	-.18			8.91	5.24	6.05	276	4	2.546
19>	Pectolite-1\ITA\RG - NaCa2HSi3O9	+	33-1223	16.4	31	-.12	2.8	P-1 (2)	7.03	8.00	7.03	384	2	2.872
20>	Rhodesite - (Ca,K,Na)8Si16O40!11	+	22-1253	16.8	35	0.06		P21/n (14)	9.62	23.96	9.51	2186	2	2.360
21>	Wollastonite-1\ITA\RG - CaSiO3	+	42- 547	17.6	42	-.06	1.0	P-1 (2)	7.30	7.90	7.05	394	6	2.937
22>	Xonotlite, syn - Ca6Si6O17(OH)2	+	23- 125	17.8	18	0.00		P2/a (13)	17.02	7.35	7.00	877	2	2.709
23>	Wollastonite-2\ITM\RG - CaSiO3	+	43-1460	17.9	36	-.12		P21/a (14)	15.43	7.32	7.07	795	12	2.910
24>	Ianthinite - U6O7(OH)2O		12- 272	18.8	33	-.18		C ()	11.52	30.30	7.15	1248	4	5.004
25>	Grumantite - NaSi2O4(OH)!H2O		42-1331	19.0	23	-.06		F ()	16.00	18.24	7.18	524	16	2.259
26>	Unnamed mineral [NR] - K-Ca-CO3	?	25- 627	19.2	33	0.06								
27>	Quartz, syn - SiO2	+	33-1161	19.4	26	-.18	3.6	P3221 (154)	4.91	4.91	5.41	113	3	2.649
28>	Tobermorite-11A, syn - Ca5(OH)2S	+	19-1364	19.5	18	0.00		B2212 (20)	11.27	22.74	7.35	942	4	2.578
29>	Rameauite - K2Ca(UO2)6O8!9H2O	+	25- 631	19.5	14	0.06		C*/c (15)	13.97	14.26	13.88	1214	4	5.550
30>	Wollastonite-1\ITA\RG - CaSiO3	+	42- 550	20.3	36	-.18	0.9	P-1 (2)	7.31	7.91	7.06	396	6	2.925
31>	Fairchildite, syn - K2Ca(CO3)2	+	21-1287	20.9	36	0.00	1.5	P63/mmc (194)	5.29	5.29	13.35	324	2	2.441
32>	Hydrohalite - NaCl!2H2O	?	29-1197	21.1	15	-.18		P21/a (14)	6.50	10.12	6.33	379	4	1.654
	Compreignacite, syn - K2(UO2)6O4	+	33-1049	21.2	9	-.06		Pmnn (58)	12.19	14.85	7.16	1296	2	5.146
	Sodiumboltwoodite - (Na,K)(H3O)U		29-1044	21.8	29	0.06		P212121 (19)	7.02	27.40	6.65	1279	8	4.100
35>	Liebigite - Ca2UO2(CO3)3!10H2O	+	11- 296	21.9	60	0.18		Bba2 (41)	16.70	17.51	13.74	2010	8	2.348
36>	Tokkoite - K2Ca4Si7O17(OH)4	+	40- 517	22.1	14	0.06		P-1 (2)	10.37	25.39	7.27	1879	4	2.741
37>	Haiweeite - Ca(UO2)2Si6O15!5H2O		12- 721	23.3	16	-.06		A ()	17.65	18.58	14.20	2329	8	3.077
38>	Melanophlogite - C2H17O5!Si46O92	+	25- 7	23.4	26	0.06		P42/nbc (133)	26.79	26.79	13.40	9614	4	1.993
39>	Uranophane-$GB - Ca(UO2)2(SiO3OH	+	8- 301	23.8	63	0.00		P21/a (14)	14.01	15.55	6.64	1446	4	3.933
40>	Soddyite, syn - (UO2)2(SiO4)!2H2	+	35- 733	24.0	13	0.06		Fddd (70)	11.27	18.65	8.30	436	8	5.089

* QM - ? for Doubtful Quality or Non-ambient patterns; + for Indexed patterns with Space-Group, Unit Cell & Density.
* vol - reduced-cell volume; dx - measured density if calculated is not available.

Current S/M parameters:

PDF Subfile to Search ..... MINERALS
Chemistry Filter ..... NF.CHM (Yes)
Search Focus on ..... Major Phase(s)
Preferred Orientation in Sample ..... No
Search only High Quality Phases ..... No
Exclude Questionable Phases ..... No

2-Theta Error Window ..... .18
Sensitivity to Matching Intensity 5
Sensitivity to Matching 2-Theta 5
Maximum Number of Hits to Save 40
Rubber-Ruler Search - %Elasticity 0
Required 100% Line in Srched Range ... No

========== Southwest Research Institute ==========

Jade: Peak Listing Tue May 30 1995 @3:58pm

File: NFGY.MDI> 5/30/95 - NFGY-XRD

Scan Parameters:	Search Parameters:
Radiation = CU_1.54059	Filter length(pts) = 25
Scan Range = 2- 70	Noise level(sigmas) = 3.0
Step Size = .02	Intensity cutoff(%) = 1.0-100
Count Time = 2 sec.	2-Theta Zero (degs) = 0

	Peak-Position		Centroid-Position		Peak & Area are without Bkgrd					
#	2Theta	d	2Theta	d	Bkgrd	Peak	I%	Area	I%	FWHM*
1:	7.444	11.8654	7.444	11.8654	32	36	5.2	2	1.1	0.050
2:	7.545	11.7068	7.545	11.7068	31	24	3.5	2	1.1	0.075
3:	9.920	8.9093	9.920	8.9093	31	75	10.8	4	2.2	0.048
4:	11.300	7.8240	11.278	7.8391	43	502	72.2	140	75.7	0.251
5:	11.777	7.5080	11.777	7.5080	51	58	8.3	3	1.6	0.047
6:	12.600	7.0199	12.600	7.0198	42	254	36.5	78	42.2	0.276
7:	13.081	6.7624	13.073	6.7666	46	695	100.0	185	100.0	0.240
8:	13.479	6.5636	13.453	6.5763	47	421	60.6	91	49.2	0.195
9:	14.380	6.1546	14.380	6.1546	42	68	9.8	6	3.2	0.079
10:	14.839	5.9651	14.839	5.9650	40	205	29.5	42	22.7	0.184
11:	15.237	5.8101	15.237	5.8103	36	47	6.8	6	3.2	0.115
12:	16.000	5.5348	16.000	5.5348	39	132	19.0	27	14.6	0.184
13:	16.381	5.4068	16.379	5.4075	35	186	26.8	44	23.8	0.213
14:	18.540	4.7818	18.532	4.7838	26	377	54.2	111	60.0	0.265
15:	19.521	4.5437	19.523	4.5432	22	102	14.7	25	13.5	0.221
16:	20.380	4.3541	20.380	4.3541	24	50	7.2	4	2.2	0.072
17:	20.742	4.2790	20.740	4.2794	24	62	8.9	15	8.1	0.218
18:	22.641	3.9241	22.634	3.9253	23	430	61.9	136	73.5	0.285
19:	23.261	3.8209	23.253	3.8222	25	79	11.4	25	13.5	0.285
20:	23.757	3.7423	23.756	3.7425	27	61	8.8	10	5.4	0.148
21:	23.920	3.7171	23.918	3.7174	28	60	8.6	18	9.7	0.270
22:	24.018	3.7021	24.019	3.7020	29	76	10.9	8	4.3	0.095
23:	24.741	3.5957	24.747	3.5948	37	130	18.7	29	15.7	0.201
24:	25.317	3.5151	25.319	3.5148	42	171	24.6	53	28.6	0.279
25:	25.801	3.4503	25.795	3.4510	35	166	23.9	49	26.5	0.266
26:	26.441	3.3681	26.426	3.3701	41	202	29.1	56	30.3	0.250
27:	27.140	3.2830	27.140	3.2830	65	101	14.5	22	11.9	0.196
28:	27.939	3.1909	27.950	3.1896	45	287	41.3	77	41.6	0.241
29:	28.339	3.1467	28.340	3.1467	49	106	15.3	15	8.1	0.127
30:	28.980	3.0786	28.975	3.0791	50	140	20.1	32	17.3	0.206
31:	29.920	2.9840	29.925	2.9835	46	371	53.4	102	55.1	0.247
32:	30.578	2.9213	30.579	2.9212	43	393	56.5	175	94.6	0.401
33:	31.380	2.8484	31.375	2.8488	41	48	6.9	6	3.2	0.112
34:	32.060	2.7896	32.060	2.7896	40	41	5.9	3	1.6	0.066
35:	33.338	2.6854	33.335	2.6857	37	110	15.8	20	10.8	0.164
36:	34.199	2.6198	34.200	2.6197	39	47	6.8	10	5.4	0.191
37:	34.782	2.5772	34.777	2.5776	34	44	6.3	14	7.6	0.286
38:	35.482	2.5279	35.482	2.5280	29	52	7.5	6	3.2	0.104
39:	35.897	2.4996	35.888	2.5003	30	74	10.6	21	11.4	0.255
40:	37.439	2.4002	37.437	2.4003	19	69	9.9	15	8.1	0.196
41:	38.001	2.3659	38.002	2.3659	17	41	5.9	13	7.0	0.285
42:	39.582	2.2750	39.582	2.2750	33	49	7.1	5	2.7	0.092
43:	39.639	2.2719	39.637	2.2720	21	68	9.8	14	7.6	0.185

#	2Theta	d	2Theta	d	Bkgrd	Peak	I%	Area	I%	FWHM*
44:	39.942	2.2553	39.943	2.2553	19	65	9.4	13	7.0	0.180
45:	40.320	2.2350	40.314	2.2354	21	64	9.2	13	7.0	0.183
46:	41.080	2.1954	41.080	2.1954	26	120	17.3	16	8.6	0.120
47:	42.223	2.1386	42.228	2.1384	32	40	5.8	7	3.8	0.157
48:	42.359	2.1321	42.359	2.1321	34	36	5.2	2	1.1	0.050
49:	43.179	2.0934	43.184	2.0932	29	161	23.2	65	35.1	0.363
50:	44.043	2.0544	44.045	2.0543	31	58	8.3	13	7.0	0.202
51:	44.097	2.0520	44.096	2.0521	44	44	6.3	8	4.3	0.164
52:	44.477	2.0354	44.477	2.0354	35	31	4.5	4	2.2	0.116
53:	45.596	1.9880	45.591	1.9881	36	51	7.3	5	2.7	0.088
54:	46.140	1.9658	46.141	1.9657	39	125	18.0	9	4.9	0.065
55:	46.279	1.9602	46.280	1.9602	40	91	13.1	21	11.4	0.208
56:	47.564	1.9102	47.562	1.9103	44	56	8.1	9	4.9	0.145
57:	48.002	1.8938	48.001	1.8938	44	75	10.8	13	7.0	0.156
58:	48.079	1.8909	48.091	1.8905	44	85	12.2	26	14.1	0.275
59:	48.500	1.8755	48.500	1.8755	39	113	16.3	10	5.4	0.080
60:	48.897	1.8612	48.895	1.8612	35	93	13.4	42	22.7	0.406
61:	49.280	1.8476	49.280	1.8476	36	50	7.2	6	3.2	0.108
62:	50.021	1.8220	50.015	1.8222	40	46	6.6	11	5.9	0.215
63:	51.324	1.7787	51.324	1.7787	41	41	5.9	2	1.1	0.044
64:	51.760	1.7648	51.760	1.7648	40	43	6.2	10	5.4	0.209
65:	51.819	1.7629	51.809	1.7632	33	57	8.2	18	9.7	0.284
66:	52.272	1.7487	52.272	1.7487	32	60	8.6	4	2.2	0.060
67:	52.979	1.7270	52.979	1.7270	32	83	11.9	10	5.4	0.108
68:	53.601	1.7084	53.594	1.7086	35	39	5.6	7	3.8	0.162
69:	54.397	1.6853	54.398	1.6852	33	28	4.0	5	2.7	0.161
70:	54.760	1.6750	54.761	1.6749	34	54	7.8	12	6.5	0.200
71:	55.080	1.6660	55.093	1.6656	35	68	9.8	28	15.1	0.371
72:	55.200	1.6626	55.189	1.6629	35	57	8.2	16	8.6	0.253
73:	55.598	1.6517	55.605	1.6515	36	53	7.6	17	9.2	0.289
74:	55.838	1.6451	55.839	1.6451	36	44	6.3	11	5.9	0.225
75:	56.977	1.6149	56.977	1.6149	36	37	5.3	2	1.1	0.049
76:	57.604	1.5989	57.604	1.5989	34	36	5.2	2	1.1	0.050
77:	57.913	1.5910	57.913	1.5910	34	28	4.0	2	1.1	0.064
78:	58.480	1.5770	58.486	1.5768	37	63	9.1	9	4.9	0.129
79:	58.557	1.5751	58.554	1.5752	41	46	6.6	4	2.2	0.078
80:	59.158	1.5605	59.163	1.5604	31	35	5.0	3	1.6	0.077
81:	59.640	1.5490	59.635	1.5492	28	34	4.9	11	5.9	0.291
82:	59.962	1.5415	59.963	1.5415	27	41	5.9	7	3.8	0.154
83:	61.742	1.5012	61.744	1.5012	21	50	7.2	9	4.9	0.162
84:	62.059	1.4943	62.061	1.4943	20	64	9.2	15	8.1	0.211
85:	62.218	1.4909	62.219	1.4909	20	58	8.3	18	9.7	0.279
86:	62.376	1.4875	62.365	1.4877	19	34	4.9	5	2.7	0.132
87:	63.281	1.4684	63.281	1.4684	19	36	5.2	4	2.2	0.100
88:	63.918	1.4553	63.918	1.4553	22	47	6.8	22	11.9	0.421
89:	64.760	1.4384	64.760	1.4384	21	35	5.0	4	2.2	0.103
90:	64.922	1.4352	64.922	1.4352	23	35	5.0	3	1.6	0.077
91:	65.457	1.4247	65.457	1.4247	26	22	3.2	2	1.1	0.082
92:	68.158	1.3747	68.158	1.3747	23	24	3.5	2	1.1	0.075
93:	68.341	1.3715	68.336	1.3716	22	29	4.2	3	1.6	0.093

* Intensity values are based on total raw counts.

Revised procedure for uranophane synthesis (05/17/95):

Use 1300 g deionized, degassed H_2O, 35 g Ca-Ac, 42 g U-Ac, and 28 g Na-metasilicate. The solids will be placed inside the teflon-lined vessel, the vessel will be capped and subsequently evacuated to remove any $CO_2(g)$. Then 1300 g of deionized, degassed H_2O (with pH lowered to 1.0 or lower by addition of HCl to compensate for any pH increase due to dissolution of the metasilicate) will be introduced into the vessel (pulled in by vacuum). The temperature will then be raised to 150C and the reaction allowed to occur for one week or longer. After this time period, the yellow solids will be analyzed by XRD and the pH of the solution will be measured.

NFY2.MDI> 5/2/95 - NFY2-XRD1

	Hits Sorted on Figure-Of-Merit	QM*	PDF-#	FOM	I%	OFF	RIR	Space-Group	a	b	c	Vol*	Z	Dx*
1>	Hillebrandite - Ca2(SiO3)(OH)2	+	42- 538	6.4	43	-.18		A*a* (63)	11.84	16.32	3.64	352	6	2.693
2>	Uranophane - Ca(UO2)2(SiO3OH)2!5	+	39-1360	6.5	29	-.12		P21 (4)	15.92	7.01	6.67	739	2	3.849
3>	Urancalcarite - Ca(UO2)3CO3(OH)6	+	38- 350	7.5	28	0.12		Pbn* (62)	15.42	16.08	6.97	1728	4	4.098
4>	Lonsdaleite, syn - C		19- 268	7.8	12	0.06		P63/mmc (194)	2.52	2.52	4.12	23	4	3.521
5>	Boltwoodite - K(H3O)(UO2)(SiO4)	+	35- 490	7.9	39	0.00		P21 (4)	7.07	7.06	6.64	319	2	4.372
6>	Grumantite - NaSi2O4(OH)!H2O		42-1331	8.0	34	0.18		F ()	16.00	18.24	7.18	524	16	2.259
7>	Diamond - C	+	6- 675	9.0	8	0.00		Fd3m (227)	3.57	3.57	3.57	11	8	3.517
8>	Hydroxyapophyllite - KCa4Si8O20(	+	29- 994	9.0	36	0.12		P4/mnc (128)	8.98	8.98	15.83	1276	2	2.356
9>	Scawtite - Ca7(Si6O18)(CO3)!2H2O		31- 261	10.2	30	0.12		I2/m (12)	10.12	15.18	6.62	500	2	2.766
10>	Rosenhahnite - Ca3(Si3O8(OH)2)	+	29- 378	10.4	27	0.12		P-1 (2)	6.95	9.48	6.81	420	2	2.899
11>	Hydroxyapophyllite - KCa4Si8O20(	+	30- 920	10.7	18	-.18	0.8	P4/mnc (128)	8.98	8.98	15.83	1276	2	2.356
12>	Dellaite, syn - Ca6(SiO4)(Si2O7)	+	29- 376	11.0	11	0.12		P-1 (2)	6.93	12.88	6.82	597	2	2.975
13>	Tobermorite-11A, syn - Ca5(OH)2S	+	19-1364	12.0	21	-.06		B2212 (20)	11.27	22.74	7.35	942	4	2.578
14>	Tilleyite - Ca5Si2O7(CO3)2	+	24- 184	12.3	26	-.06		P21/n (14)	15.02	10.24	7.58	1132	4	2.867
15>	Foshagite, syn - Ca4(SiO3)3(OH)2	+	29- 377	12.3	62	0.18		P21/m (11)	10.41	3.66	7.03	256	1	2.739
16>	Uranophane-$GB - Ca(UO2)2(SiO3OH	+	8- 301	12.7	26	-.18		P21/a (14)	14.01	15.55	6.64	1446	4	3.933
17>	Sodiumboltwoodite - (Na,K)(H3O)U		29-1044	12.8	27	0.00		P212121 (19)	7.02	27.40	6.65	1279	8	4.100
18>	Unnamed mineral [NR] - UO3-H2O	?	15- 569	13.1	26	-.06								
19>	Joliotite - (UO2)CO3!2H2O		29-1378	13.3	26	0.18		P*** (47)	8.16	10.35	6.32	534	4	4.555
20>	Paraspurrite - Ca5(SiO4)2CO3	+	29- 307	13.3	20	0.06		P21/c (14)	27.78	6.71	10.47	1950	8	3.028
21>	Nahcolite, syn - NaHCO3	+	15- 700	13.3	62	0.00	0.3	P21/n (14)	7.47	9.69	3.48	252	4	2.218
22>	Gaylussite - Na2Ca(CO3)2!5H2O	+	21- 343	13.4	13	0.06	0.4	I*/a (15)	11.58	7.78	11.21	494	4	1.993
23>	Whewellite, syn - C2CaO4!H2O	+	20- 231	13.7	21	-.18		P21/n (14)	9.98	7.29	6.29	438	4	2.217
24>	Weddellite, syn - C2CaO4!2H2O	+	17- 541	13.8	14	0.18		I4/m (87)	12.35	12.35	7.36	562	8	1.941
25>	Coesite, syn - SiO2		14- 654	13.9	30	0.00		P21/n (14)	7.17	12.38	7.17	551	16	2.896
26>	Riversideite-9A - Ca5Si6O16(OH)2		29- 329	14.0	30	0.06		P ()	5.57	18.79	3.64	381	1	2.871
27>	Xonotlite, syn - Ca6Si6O17(OH)2	+	23- 125	14.0	21	-.06		P2/a (13)	17.02	7.35	7.00	877	2	2.709
28>	Aragonite - CaCO3	+	41-1475	14.1	26	0.00	1.0	Pnam (62)	5.74	7.97	4.96	227	4	2.927
29>	Metahaiweeite - CaO!2UO3!6SiO2!x		12- 722	14.1	29	0.06								
30>	Rhodesite - (Ca,K,Na)8Si16O40!11	+	22-1253	14.5	24	-.12		P21/n (14)	9.62	23.96	9.51	2186	2	2.360
31>	B\PIutschliite, syn - K2Ca(CO3)2	+	25- 626	15.0	9	-.06		R-3m (166)	5.38	5.38	18.12	151	3	2.614
32>	Flagstaffite, syn - CH3(OH)C6H9C		28-2014	15.2	18	0.06		Fdd2 (43)	18.50	22.60	11.00	1150	16	1.099
	Larnite, syn - Ca2SiO4	+	33- 302	15.3	6	0.00		P21/n (14)	9.31	6.76	5.51	345	4	3.313
	Natrite - Na2CO3		37- 451	15.4	43	0.12			8.91	5.24	6.05	276	4	2.546
35>	Magadiite, syn - Na2Si14O29!10H2		42-1350	15.9	34	-.18		P ()	15.71	7.28	7.30	830	1	2.168
36>	Weeksite - K2(UO2)2(Si6O15)!4H2O		12- 462	16.0	10	-.06		Pnna (52)	14.26	35.88	14.20	7265	16	4.018
37>	Killalaite - 2Ca3Si2O7!H2O		26-1070	16.3	12	0.18		P21/m (11)	6.81	15.46	6.81	710	2	2.782
38>	Vaterite - CaCO3	+	33- 268	16.6	12	-.18		P63/mmc (194)	7.15	7.15	16.92	748	12	2.665
39>	Soddyite - (UO2)2(SiO4)!2H2O	+	35- 491	16.6	10	0.12		Fddd (70)	11.21	18.71	8.32	436	8	5.087
40>	Killalaite - Ca3.2(H0.6Si2O7)(OH	+	29- 332	16.9	11	0.12	0.8	P21/m (11)	6.81	15.46	6.81	710	4	2.937

* QM - ? for Doubtful Quality or Non-ambient patterns; + for Indexed patterns with Space-Group, Unit Cell & Density.
* vol - reduced-cell volume; dx - measured density if calculated is not available.

Current S/M parameters:

PDF Subfile to Search ..... MINERALS
Chemistry Filter ..... NF,CHM (Yes)
Search Focus on ..... Major Phase(s)
Preferred Orientation in Sample ..... No
Search only High Quality Phases ..... No
Exclude Questionable Phases ..... No

2-Theta Error Window ..... .18
Sensitivity to Matching Intensity 5
Sensitivity to Matching 2-Theta 5
Maximum Number of Hits to Save 40
Rubber-Ruler Search - %Elasticity 0
Required 100% Line in Srched Range ... No

========== Southwest Research Institute ==========

Jade: Peak Listing Tue May 02 1995 @3:50pm

File: NFY2.MDI> 5/2/95 - NFY2-XRD1

Scan Parameters:	Search Parameters:
Radiation = CU_1.54059	Filter length(pts) = 25
Scan Range = 2- 70	Noise level(sigmas) = 3.0
Step Size = .02	Intensity cutoff(%) = 1.0-100
Count Time = 2 sec.	2-Theta Zero (degs) = 0

	Peak-Position		Centroid-Position		Peak & Area are without Bkgrd					
#	2Theta	d	2Theta	d	Bkgrd	Peak	I%	Area	I%	FWHM*
1:	9.720	9.0926	9.720	9.0925	39	32	3.4	3	1.0	0.084
2:	9.792	9.0251	9.791	9.0266	39	33	3.5	4	1.3	0.109
3:	11.061	7.9930	11.065	7.9897	49	302	32.1	75	24.7	0.224
4:	11.599	7.6234	11.585	7.6324	50	107	11.4	15	4.9	0.126
5:	12.342	7.1659	12.341	7.1662	51	99	10.5	11	3.6	0.100
6:	12.860	6.8783	12.862	6.8771	53	941	100.0	304	100.0	0.291
7:	13.280	6.6616	13.280	6.6616	50	462	49.1	88	28.9	0.171
8:	14.222	6.2225	14.231	6.2184	52	132	14.0	30	9.9	0.205
9:	14.641	6.0453	14.631	6.0493	50	436	46.3	117	38.5	0.242
10:	15.821	5.5970	15.831	5.5934	40	68	7.2	10	3.3	0.132
11:	16.218	5.4608	16.212	5.4628	36	112	11.9	38	12.5	0.305
12:	18.360	4.8284	18.343	4.8328	33	576	61.2	147	48.4	0.230
13:	19.320	4.5906	19.320	4.5904	33	65	6.9	9	3.0	0.125
14:	20.180	4.3969	20.180	4.3968	29	57	6.1	8	2.6	0.126
15:	20.879	4.2512	20.879	4.2512	30	56	6.0	9	3.0	0.145
16:	22.461	3.9551	22.466	3.9544	32	501	53.2	142	46.7	0.255
17:	23.602	3.7665	23.624	3.7630	33	121	12.9	47	15.5	0.350
18:	23.700	3.7512	23.687	3.7532	33	119	12.6	50	16.4	0.378
19:	24.520	3.6275	24.521	3.6273	64	88	9.4	15	4.9	0.153
20:	25.182	3.5337	25.199	3.5313	47	107	11.4	21	6.9	0.177
21:	25.601	3.4768	25.601	3.4768	44	402	42.7	51	16.8	0.114
22:	26.259	3.3911	26.232	3.3945	47	358	38.0	81	26.6	0.204
23:	26.821	3.3213	26.824	3.3210	71	68	7.2	8	2.6	0.106
24:	26.918	3.3095	26.916	3.3098	64	75	8.0	16	5.3	0.192
25:	27.758	3.2113	27.757	3.2114	47	177	18.8	44	14.5	0.224
26:	28.160	3.1664	28.160	3.1664	50	48	5.1	3	1.0	0.056
27:	28.821	3.0952	28.813	3.0961	67	349	37.1	73	24.0	0.188
28:	29.700	3.0055	29.707	3.0049	50	356	37.8	108	35.5	0.273
29:	30.359	2.9419	30.361	2.9416	49	875	93.0	259	85.2	0.266
30:	31.185	2.8658	31.185	2.8658	59	95	10.1	6	2.0	0.057
31:	31.801	2.8117	31.800	2.8117	45	61	6.5	8	2.6	0.118
32:	31.877	2.8051	31.874	2.8054	45	69	7.3	14	4.6	0.183
33:	32.118	2.7846	32.117	2.7847	44	56	6.0	9	3.0	0.145
34:	32.538	2.7497	32.534	2.7499	41	42	4.5	4	1.3	0.086
35:	33.160	2.6994	33.163	2.6992	42	56	6.0	5	1.6	0.080
36:	33.978	2.6363	33.978	2.6363	37	35	3.7	3	1.0	0.077
37:	34.620	2.5889	34.614	2.5893	35	121	12.9	35	11.5	0.260
38:	35.282	2.5418	35.286	2.5415	32	59	6.3	14	4.6	0.214
39:	35.719	2.5117	35.706	2.5126	29	143	15.2	39	12.8	0.245
40:	36.126	2.4843	36.126	2.4843	27	31	3.3	3	1.0	0.087
41:	37.082	2.4224	37.085	2.4223	25	44	4.7	13	4.3	0.266
42:	37.242	2.4124	37.241	2.4125	26	41	4.4	8	2.6	0.176
43:	39.400	2.2851	39.400	2.2851	42	33	3.5	4	1.3	0.109

#	2Theta	d	2Theta	d	Bkgrd	Peak	I%	Area	I%	FWHM*
44:	39.759	2.2653	39.752	2.2657	30	64	6.8	12	3.9	0.169
45:	40.121	2.2457	40.124	2.2455	31	64	6.8	6	2.0	0.084
[illegible]:	40.420	2.2297	40.420	2.2298	32	69	7.3	24	7.9	0.313
47:	40.980	2.2006	40.985	2.2003	34	145	15.4	62	20.4	0.385
48:	41.281	2.1852	41.273	2.1856	40	131	13.9	29	9.5	0.199
49:	42.519	2.1244	42.519	2.1244	44	63	6.7	3	1.0	0.043
50:	43.038	2.1000	43.040	2.0999	38	171	18.2	75	24.7	0.395
51:	43.499	2.0788	43.499	2.0788	39	95	10.1	10	3.3	0.095
52:	43.897	2.0609	43.901	2.0607	47	79	8.4	16	5.3	0.182
53:	45.483	1.9926	45.480	1.9928	45	76	8.1	32	10.5	0.379
54:	45.922	1.9746	45.925	1.9745	47	115	12.2	31	10.2	0.243
55:	46.480	1.9522	46.479	1.9522	49	39	4.1	6	2.0	0.138
56:	47.298	1.9203	47.295	1.9204	55	46	4.9	9	3.0	0.176
57:	47.420	1.9156	47.420	1.9156	55	49	5.2	5	1.6	0.092
58:	48.340	1.8813	48.340	1.8813	41	184	19.6	34	11.2	0.166
59:	49.061	1.8554	49.058	1.8554	36	100	10.6	25	8.2	0.225
60:	49.615	1.8359	49.618	1.8358	56	72	7.7	9	3.0	0.112
61:	49.761	1.8309	49.766	1.8307	50	67	7.1	11	3.6	0.148
62:	49.881	1.8268	49.865	1.8273	45	48	5.1	10	3.3	0.188
63:	51.662	1.7679	51.661	1.7679	33	43	4.6	5	1.6	0.105
64:	52.120	1.7534	52.119	1.7535	34	71	7.5	14	4.6	0.177
65:	52.241	1.7496	52.241	1.7496	34	64	6.8	40	13.2	0.563
66:	52.799	1.7325	52.803	1.7323	39	106	11.3	35	11.5	0.297
67:	54.100	1.6938	54.100	1.6938	40	44	4.7	5	1.6	0.102
68:	54.157	1.6922	54.160	1.6921	40	39	4.1	10	3.3	0.231
69:	54.564	1.6805	54.576	1.6802	42	72	7.7	10	3.3	0.125
70:	54.779	1.6744	54.780	1.6744	42	89	9.5	11	3.6	0.111
[illegible]:	54.897	1.6711	54.902	1.6710	43	106	11.3	24	7.9	0.204
[illegible]2:	54.980	1.6688	54.980	1.6688	43	83	8.8	6	2.0	0.065
73:	55.398	1.6572	55.404	1.6570	45	66	7.0	27	8.9	0.368
74:	55.739	1.6478	55.736	1.6479	47	53	5.6	9	3.0	0.153
75:	56.760	1.6206	56.763	1.6205	42	49	5.2	9	3.0	0.165
76:	58.323	1.5808	58.322	1.5809	33	70	7.4	12	3.9	0.154
77:	58.399	1.5790	58.388	1.5792	43	76	8.1	15	4.9	0.178
78:	59.779	1.5458	59.772	1.5459	32	45	4.8	5	1.6	0.100
79:	61.602	1.5043	61.603	1.5043	25	75	8.0	14	4.6	0.168
80:	61.942	1.4969	61.941	1.4969	24	85	9.0	14	4.6	0.148
81:	62.039	1.4948	62.040	1.4947	24	68	7.2	27	8.9	0.357
82:	63.184	1.4704	63.198	1.4701	26	40	4.3	9	3.0	0.203
83:	63.257	1.4689	63.253	1.4690	27	52	5.5	5	1.6	0.087
84:	63.822	1.4572	63.821	1.4573	30	48	5.1	10	3.3	0.188
85:	69.080	1.3586	69.080	1.3586	36	31	3.3	3	1.0	0.087

* Intensity values are based on total raw counts.

NFY1.MDI> 4/25/95 - NFY1-XRD1

	Hits Sorted on Figure-Of-Merit	QM*	PDF-#	FOM	I%	OFF	RIR	Space-Group	a	b	c	Vol*	Z	Dx*
1>	Compreignacite, syn - K2(UO2)6O4	+	33-1049	10.7	54	-.18		Pmnn (58)	12.19	14.85	7.16	1296	2	5.146
2>	Becquerelite, syn - Ca(UO2)6O4(O	+	29- 389	11.6	65	-.12		Pna21 (33)	13.82	14.94	12.39	2558	4	5.116
3>	Paraschoepite, syn - UO2.86!1.5H		23-1461	13.4	35	-.12		Pcab (61)	15.04	18.98	14.23	4062	44	5.590
4>	Boltwoodite - K(H3O)(UO2)(SiO4)	+	35- 490	14.5	18	0.06		P21 (4)	7.07	7.06	6.64	319	2	4.372
5>	Schoepite - UO3!2H2O		13- 407	14.8	85	-.42		Pcab (61)	14.73	16.79	14.33	3544	32	4.829
6>	Ianthinite - U6O7(OH)2O		12- 272	16.8	28	0.30		C ()	11.52	30.30	7.15	1248	4	5.004
7>	Metaschoepite, syn - UO3!2H2O		43- 364	17.3	76	-.36			14.67	16.70	13.98	3424		
8>	Schoepite, syn - UO3!2H2O	+	29-1376	17.5	28	-.12		Pcab (61)	14.74	16.66	14.36	3526	32	4.853
9>	Compreignacite - K2(UO2)6O4(OH)6	+	17- 167	18.0	43	-.30		Pmnn (58)	12.14	14.88	7.16	1293	2	5.157
10>	Unnamed mineral [NR] - UO3-H2O	?	15- 569	23.5	22	0.42								
11>	Schoepite - UO3!2H2O		13- 241	24.6	77	-.24		Pcab (61)	14.73	16.79	14.33	3544	32	4.829
12>	Metacalciouranoite - CaU2O7!11H2		26-1003	28.7	13	-.06								4.620
13>	Uranophane-$GB - Ca(UO2)2(SiO3OH	+	8- 301	30.0	22	0.30		P21/a (14)	14.01	15.55	6.64	1446	4	3.933
14>	Uranophane - Ca(UO2)2(SiO3OH)2!5	+	39-1360	32.2	28	0.42		P21 (4)	15.92	7.01	6.67	739	2	3.849
15>	Sodiumboltwoodite - (Na,K)(H3O)U		29-1044	33.8	14	-.18		P212121 (19)	7.02	27.40	6.65	1279	8	4.100
16>	Soddyite - (UO2)2(SiO4)!2H2O	+	35- 491	40.8	36	0.24		Fddd (70)	11.21	18.71	8.32	436	8	5.087
17>	Metastudtite - UO4!2H2O		35- 571	41.0	41	0.18		Immm (71)	6.51	8.78	4.21	120	2	4.666
18>	Uranosilite - USi7O17		37- 417	49.4	36	-.24		P21212 (18)	12.83	14.68	11.60	2185	6	3.222
19>	Coffinite, syn - USiO4	+	11- 420	53.7	33	-.42		I41/amd (141)	6.98	6.98	6.25	152	4	7.201

* QM - ? for Doubtful Quality or Non-ambient patterns; + for Indexed patterns with Space-Group, Unit Cell & Density.
* vol - reduced-cell volume; dx - measured density if calculated is not available.

Current S/M parameters:

PDF Subfile to Search ..... MINERALS
Chemistry Filter ..... NF.CHM (Yes)
Search Focus on ..... Major Phase(s)
Preferred Orientation in Sample ..... No
Search only High Quality Phases ..... No
Exclude Questionable Phases ..... No

2-Theta Error Window ..... .42
Sensitivity to Matching Intensity 5
Sensitivity to Matching 2-Theta 5
Maximum Number of Hits to Save 40
Rubber-Ruler Search - %Elasticity 0
Required 100% Line in Srched Range ... No

NFYW1.MDI> 4/25/95 - NFYW1-XRD1

	Hits Sorted on Figure-Of-Merit	QM*	PDF-#	FOM	I%	OFF	RIR	Space-Group	a	b	c	Vol*	Z	Dx*
1>	Unnamed mineral, syn [NR] - C4H6		30- 221	5.7	39	-.06			13.36	17.54	11.87	2782	16	1.683
2>	Moissanite-3\ITC\RG, syn - SiC	+	29-1129	7.0	10	0.00		F-43m (216)	4.36	4.36	4.36	21	4	3.216
3>	Hoelite, syn - C6H4(CO)2C6H4	+	28-2002	7.3	35	0.06		P21/a (14)	15.81	3.97	7.88	482	2	1.435
4>	Schoepite - UO3!2H2O		13- 241	7.6	80	-.30		Pcab (61)	14.73	16.79	14.33	3544	32	4.829
5>	Wyartite-17A - Ca3U(UO2)6(CO3)2(	?	12- 636	8.3	62	-.24		Pmnb (62)	11.25	16.83	7.10	1344	2	6.074
6>	Becquerelite, syn - Ca(UO2)6O4(O	+	29- 389	8.3	42	-.18		Pna21 (33)	13.82	14.94	12.39	2558	4	5.116
7>	Foshagite, syn - Ca4(SiO3)3(OH)2	+	29- 377	8.7	25	-.12		P21/m (11)	10.41	3.66	7.03	256	1	2.739
8>	Diamond - C	+	6- 675	9.0	12	0.06		Fd3m (227)	3.57	3.57	3.57	11	8	3.517
9>	Wegscheiderite - Na2CO3!3NaHCO3	+	15- 653	9.1	22	-.18		P-1 (2)	10.04	15.56	3.47	509	2	2.336
10>	Uranophane - Ca(UO2)2(SiO3OH)2!5	+	39-1360	9.4	33	0.42		P21 (4)	15.92	7.01	6.67	739	2	3.849
11>	Compreignacite, syn - K2(UO2)6O4	+	33-1049	9.5	31	0.00		Pmnn (58)	12.19	14.85	7.16	1296	2	5.146
12>	Wyartite-21A - Ca3U7C2O22(OH)16!	+	12- 635	9.8	75	0.30		P212121 (19)	11.25	20.80	7.10	1661	2	5.011
13>	Wollastonite-1\ITA\RG - CaSiO3	+	42- 550	9.9	24	0.06	0.9	P-1 (2)	7.31	7.91	7.06	396	6	2.925
14>	Zellerite - CaUO2(CO3)2!5H2O	+	19- 257	9.9	31	-.18		P*n* (59)	11.22	19.25	4.93	1066	4	3.243
15>	Monohydrocalcite - CaCO3!H2O	+	29- 306	10.4	56	-.18		P31 (144)	10.57	10.57	7.57	732	9	2.411
16>	Metaschoepite, syn - UO3!2H2O		43- 364	10.6	51	-.42			14.67	16.70	13.98	3424		
17>	Compreignacite - K2(UO2)6O4(OH)6	+	17- 167	10.7	26	-.36		Pmnn (58)	12.14	14.88	7.16	1293	2	5.157
18>	Wollastonite-1\ITA\RG - CaSiO3	+	42- 547	10.7	22	0.06	1.0	P-1 (2)	7.30	7.90	7.05	394	6	2.937
19>	Karpatite, syn - C6H2(C4H2)4C2H2		28-2008	10.8	25	-.42		P21/n (14)	15.56	4.70	10.03	704	2	1.416
20>	Kilchoanite, syn - Ca6(SiO4)(Si3	+	29- 370	10.9	29	0.18		Im2a (46)	11.43	22.02	5.08	639	4	2.996
21>	Urancalcarite - Ca(UO2)3CO3(OH)6	+	38- 350	11.1	30	-.36		Pbn* (62)	15.42	16.08	6.97	1728	4	4.098
22>	Graphite-3\ITR\RG, syn [NR] - C	+	26-1079	11.1	20	0.06		R3 (146)	2.46	2.46	10.04	17	6	2.281
23>	Unnamed mineral [NR] - Ca-U-Si-O	?	15- 529	11.6	29	0.36								
24>	Schoepite, syn - UO3!2H2O	+	29-1376	11.6	51	-.36		Pcab (61)	14.74	16.66	14.36	3526	32	4.853
25>	Killalaite - Ca3.2(H0.6Si2O7)(OH	+	29- 332	11.8	37	-.36	0.8	P21/m (11)	6.81	15.46	6.81	710	4	2.937
26>	Paraspurrite - Ca5(SiO4)2CO3	+	29- 307	11.9	35	-.30		P21/c (14)	27.78	6.71	10.47	1950	8	3.028
27>	Wollastonite-2\ITM\RG - CaSiO3	+	27- 88	12.0	24	0.12		P21/a (14)	15.43	7.32	7.07	794	12	2.914
28>	Paraschoepite, syn - UO2.86!1.5H		23-1461	12.5	21	-.18		Pcab (61)	15.04	18.98	14.23	4062	44	5.590
29>	Karpatite, syn - C6H2(C4H2)4C2H2		28-2007	12.6	68	-.42		P21/n (14)	15.60	4.67	10.16	710	2	1.404
30>	Hillebrandite - Ca2(SiO3)(OH)2	+	42- 538	12.7	24	-.30		A*a* (63)	11.84	16.32	3.64	352	6	2.693
31>	Hydroxyapophyllite - KCa4Si8O20(	+	30- 920	12.7	42	0.30	0.8	P4/mnc (128)	8.98	8.98	15.83	1276	2	2.356
32>	Wollastonite-2\ITM\RG - CaSiO3	+	43-1460	12.9	24	0.12		P21/a (14)	15.43	7.32	7.07	795	12	2.910
	Unnamed mineral [NR] - UO3-H2O	?	15- 569	13.2	26	0.42								
	Schoepite - UO3!2H2O		13- 407	13.2	80	-.42		Pcab (61)	14.73	16.79	14.33	3544	32	4.829
35>	Grumantite - NaSi2O4(OH)!H2O		42-1331	13.4	35	0.00		F ()	16.00	18.24	7.18	524	16	2.259
36>	Mountainite - (Ca,Na2,K2)2Si4O10		25- 676	13.4	22	-.30		P21/* (11)	13.51	13.10	13.51	2320	8	2.360
37>	Ianthinite - U6O7(OH)2O		12- 272	13.5	39	0.24		C ()	11.52	30.30	7.15	1248	4	5.004
38>	Metazellerite, syn - CaUO2(CO3)2	+	19- 258	13.5	60	0.42		Pbn* (62)	9.72	18.23	4.97	879	4	3.657
39>	Fukalite - Ca4Si2O6(CO3)(OH)2	+	29- 308	13.6	42	-.06		C*c* (63)	5.48	23.42	3.78	243	2	2.783
40>	Tridymite-2O\ITH\RG, syn - SiO2		14- 260	13.6	53	-.42		P ()	9.92	9.92	81.50	6946	160	2.298

* QM - ? for Doubtful Quality or Non-ambient patterns; + for Indexed patterns with Space-Group, Unit Cell & Density.
* vol - reduced-cell volume; dx - measured density if calculated is not available.

Current S/M parameters:

PDF Subfile to Search ..... MINERALS
Chemistry Filter ..... NF.CHM (Yes)
Search Focus on ..... Major Phase(s)
Preferred Orientation in Sample ..... No
Search only High Quality Phases ..... No
Exclude Questionable Phases ..... No

2-Theta Error Window ..... .42
Sensitivity to Matching Intensity 5
Sensitivity to Matching 2-Theta 5
Maximum Number of Hits to Save 40
Rubber-Ruler Search - %Elasticity 0
Required 100% Line in Srched Range ... No

========== Southwest Research Institute ==========

Jade: Peak Listing Wed Apr 26 1995 @4:24pm

File: NFYW1.MDI> 4/25/95 - NFYW1-XRD1

Scan Parameters:	Search Parameters:
Radiation = CU_1.54059	Filter length(pts) = 25
Scan Range = 2- 70	Noise level(sigmas) = 3.0
Step Size = .02	Intensity cutoff(%) = 1.0-100
Count Time = 2 sec.	2-Theta Zero (degs) = 0

	Peak-Position		Centroid-Position		Peak & Area are without Bkgrd					
#	2Theta	d	2Theta	d	Bkgrd	Peak	I%	Area	I%	FWHM*
1:	5.304	16.6481	5.276	16.7366	61	555	49.2	94	36.3	0.152
2:	7.486	11.7992	7.464	11.8343	45	499	44.2	98	37.8	0.177
3:	8.419	10.4939	8.417	10.4959	43	441	39.1	121	46.7	0.247
4:	8.840	9.9954	8.814	10.0248	47	884	78.4	167	64.5	0.170
5:	10.162	8.6980	10.160	8.6995	37	800	70.9	205	79.2	0.231
6:	10.599	8.3396	10.600	8.3395	35	326	28.9	43	16.6	0.119
7:	11.717	7.5466	11.714	7.5482	31	931	82.5	115	44.4	0.111
8:	12.684	6.9734	12.691	6.9693	37	73	6.5	6	2.3	0.074
9:	12.998	6.8058	12.996	6.8067	31	65	5.8	10	3.9	0.138
10:	13.721	6.4485	13.721	6.4488	28	61	5.4	9	3.5	0.133
11:	14.320	6.1801	14.300	6.1889	28	1128	100.0	259	100.0	0.207
12:	15.906	5.5675	15.892	5.5721	27	163	14.5	28	10.8	0.155
13:	16.582	5.3418	16.571	5.3453	27	493	43.7	90	34.7	0.164
14:	17.718	5.0018	17.718	5.0017	27	44	3.9	4	1.5	0.082
15:	18.540	4.7818	18.538	4.7824	28	930	82.4	160	61.8	0.155
16:	19.201	4.6188	19.199	4.6191	27	82	7.3	14	5.4	0.154
17:	20.325	4.3658	20.336	4.3634	26	678	60.1	111	42.9	0.147
18:	21.264	4.1751	21.265	4.1748	27	45	4.0	8	3.1	0.160
19:	21.699	4.0924	21.702	4.0919	27	94	8.3	16	6.2	0.153
20:	22.579	3.9347	22.596	3.9318	28	80	7.1	12	4.6	0.135
21:	23.021	3.8602	23.025	3.8595	29	106	9.4	22	8.5	0.187
22:	23.118	3.8442	23.118	3.8442	29	84	7.4	6	2.3	0.064
23:	23.500	3.7826	23.493	3.7838	31	91	8.1	16	6.2	0.158
24:	24.200	3.6747	24.198	3.6751	33	111	9.8	25	9.7	0.203
25:	24.980	3.5618	24.975	3.5625	43	466	41.3	73	28.2	0.141
26:	25.359	3.5094	25.347	3.5110	50	402	35.6	92	35.5	0.206
27:	26.360	3.3784	26.369	3.3772	34	507	44.9	127	49.0	0.225
28:	26.699	3.3362	26.688	3.3376	40	225	19.9	43	16.6	0.172
29:	27.118	3.2856	27.116	3.2858	44	109	9.7	29	11.2	0.239
30:	27.659	3.2225	27.663	3.2221	51	296	26.2	31	12.0	0.094
31:	28.881	3.0890	28.880	3.0890	48	62	5.5	13	5.0	0.189
32:	28.957	3.0810	28.958	3.0809	49	76	6.7	22	8.5	0.261
33:	29.216	3.0543	29.216	3.0543	54	65	5.8	4	1.5	0.055
34:	30.121	2.9645	30.131	2.9636	37	291	25.8	65	25.1	0.201
35:	31.282	2.8571	31.279	2.8574	50	552	48.9	100	38.6	0.163
36:	31.716	2.8190	31.728	2.8179	46	202	17.9	39	15.1	0.174
37:	32.584	2.7459	32.589	2.7455	37	64	5.7	8	3.1	0.112
38:	33.347	2.6848	33.347	2.6848	35	33	2.9	3	1.2	0.082
39:	33.701	2.6573	33.692	2.6581	40	85	7.5	15	5.8	0.159
40:	34.596	2.5906	34.583	2.5915	53	365	32.4	65	25.1	0.160
41:	35.039	2.5588	35.039	2.5588	31	69	6.1	5	1.9	0.065
42:	35.581	2.5211	35.593	2.5203	56	113	10.0	15	5.8	0.119
43:	35.977	2.4943	35.973	2.4945	49	138	12.2	11	4.2	0.072

#	2Theta	d	2Theta	d	Bkgrd	Peak	I%	Area	I%	FWHM*
44:	36.617	2.4521	36.618	2.4521	37	207	18.4	23	8.9	0.100
45:	37.598	2.3904	37.598	2.3904	33	61	5.4	11	4.2	0.162
46:	38.543	2.3339	38.539	2.3342	35	169	15.0	53	20.5	0.282
47:	39.541	2.2773	39.533	2.2777	37	37	3.3	5	1.9	0.122
48:	40.359	2.2330	40.356	2.2331	40	100	8.9	25	9.7	0.225
49:	41.359	2.1813	41.362	2.1811	44	120	10.6	19	7.3	0.142
50:	42.236	2.1380	42.238	2.1379	52	193	17.1	43	16.6	0.201
51:	43.135	2.0955	43.142	2.0952	55	309	27.4	77	29.7	0.224
52:	43.660	2.0715	43.664	2.0713	54	134	11.9	27	10.4	0.181
53:	43.976	2.0574	43.981	2.0572	54	137	12.1	29	11.2	0.191
54:	45.675	1.9847	45.679	1.9846	46	266	23.6	60	23.2	0.203
55:	46.514	1.9509	46.531	1.9502	44	83	7.4	21	8.1	0.228
56:	49.020	1.8568	49.024	1.8567	29	63	5.6	15	5.8	0.214
57:	49.718	1.8323	49.715	1.8325	34	83	7.4	24	9.3	0.260
58:	50.479	1.8065	50.478	1.8065	32	40	3.5	8	3.1	0.180
59:	51.256	1.7809	51.255	1.7809	32	204	18.1	23	8.9	0.101
60:	52.036	1.7561	52.029	1.7563	30	42	3.7	15	5.8	0.321
61:	52.759	1.7337	52.764	1.7335	32	83	7.4	15	5.8	0.163
62:	53.841	1.7014	53.845	1.7012	31	46	4.1	6	2.3	0.117
63:	54.238	1.6899	54.240	1.6898	31	49	4.3	13	5.0	0.239
64:	54.979	1.6688	54.978	1.6688	32	174	15.4	40	15.4	0.207
65:	55.692	1.6491	55.697	1.6490	43	64	5.7	12	4.6	0.169
66:	56.441	1.6290	56.441	1.6290	38	48	4.3	5	1.9	0.094
67:	57.858	1.5924	57.858	1.5924	29	32	2.8	3	1.2	0.084
68:	58.581	1.5745	58.578	1.5746	24	51	4.5	19	7.3	0.335
69:	59.833	1.5445	59.833	1.5445	22	40	3.5	4	1.5	0.090
70:	59.854	1.5440	59.857	1.5439	22	55	4.9	5	1.9	0.082
71:	60.001	1.5406	59.998	1.5406	22	36	3.2	4	1.5	0.100
72:	60.540	1.5282	60.540	1.5282	23	37	3.3	3	1.2	0.073
73:	61.242	1.5123	61.247	1.5122	27	56	5.0	6	2.3	0.096
74:	61.933	1.4971	61.941	1.4969	29	56	5.0	12	4.6	0.193
75:	63.259	1.4688	63.256	1.4689	29	85	7.5	10	3.9	0.106
76:	68.477	1.3691	68.477	1.3691	19	43	3.8	6	2.3	0.126
77:	68.659	1.3659	68.657	1.3659	19	27	2.4	4	1.5	0.133
78:	69.164	1.3572	69.164	1.3572	20	57	5.1	4	1.5	0.063

* Intensity values are based on total raw counts.

========== Southwest Research Institute ==========

Jade: Peak Listing Wed Apr 26 1995 @4:07pm

File: NFY1.MDI> 4/25/95 - NFY1-XRD1

Scan Parameters:	Search Parameters:
Radiation = CU_1.54059	Filter length(pts) = 25
Scan Range = 2- 70	Noise level(sigmas) = 3.0
Step Size = .02	Intensity cutoff(%) = 1.0-100
Count Time = 2 sec.	2-Theta Zero (degs) = 0

	Peak-Position		Centroid-Position		Peak & Area are without Bkgrd					
#	2Theta	d	2Theta	d	Bkgrd	Peak	I%	Area	I%	FWHM*
1:	11.741	7.5312	11.716	7.5475	33	1350	92.9	358	99.4	0.239
2:	13.062	6.7725	13.053	6.7773	43	275	18.9	67	18.6	0.219
3:	13.439	6.5831	13.437	6.5842	36	93	6.4	8	2.2	0.077
4:	14.401	6.1454	14.375	6.1567	37	1403	96.6	360	100.0	0.231
5:	14.855	5.9588	14.854	5.9592	39	116	8.0	15	4.2	0.116
6:	16.641	5.3230	16.640	5.3233	29	757	52.1	123	34.2	0.146
7:	18.602	4.7662	18.580	4.7717	25	1393	95.9	348	96.7	0.225
8:	20.381	4.3540	20.366	4.3571	22	917	63.1	201	55.8	0.197
9:	22.683	3.9169	22.686	3.9165	17	81	5.6	17	4.7	0.189
10:	23.600	3.7669	23.596	3.7674	16	226	15.6	49	13.6	0.195
11:	25.040	3.5534	25.025	3.5554	25	1008	69.4	207	57.5	0.185
12:	25.764	3.4552	25.772	3.4540	23	89	6.1	17	4.7	0.172
13:	26.419	3.3709	26.403	3.3729	28	755	52.0	144	40.0	0.172
14:	27.721	3.2155	27.718	3.2158	25	203	14.0	37	10.3	0.164
15:	28.997	3.0768	28.990	3.0775	22	223	15.3	38	10.6	0.153
16:	30.198	2.9572	30.196	2.9573	25	450	31.0	78	21.7	0.156
17:	30.554	2.9234	30.556	2.9233	23	139	9.6	18	5.0	0.117
18:	31.360	2.8502	31.355	2.8506	25	1453	100.0	275	76.4	0.170
19:	34.658	2.5861	34.652	2.5865	22	949	65.3	191	53.1	0.181
20:	35.680	2.5144	35.689	2.5138	20	105	7.2	21	5.8	0.180
21:	36.679	2.4481	36.693	2.4472	23	211	14.5	38	10.6	0.162
22:	38.638	2.3284	38.650	2.3277	23	340	23.4	62	17.2	0.164
23:	39.554	2.2766	39.561	2.2762	23	37	2.5	5	1.4	0.122
24:	41.419	2.1783	41.425	2.1780	27	171	11.8	40	11.1	0.211
25:	42.302	2.1348	42.310	2.1344	46	359	24.7	54	15.0	0.135
26:	43.180	2.0934	43.199	2.0926	27	849	58.4	175	48.6	0.186
27:	44.056	2.0538	44.070	2.0532	32	324	22.3	76	21.1	0.211
28:	45.738	1.9821	45.758	1.9813	27	563	38.7	116	32.2	0.185
29:	46.576	1.9484	46.585	1.9480	25	214	14.7	53	14.7	0.223
30:	48.496	1.8756	48.497	1.8756	24	41	2.8	5	1.4	0.110
31:	48.991	1.8578	49.000	1.8575	25	73	5.0	20	5.6	0.247
32:	49.778	1.8303	49.779	1.8303	25	98	6.7	13	3.6	0.119
33:	50.521	1.8051	50.523	1.8050	28	92	6.3	9	2.5	0.088
34:	50.621	1.8018	50.618	1.8019	28	46	3.2	8	2.2	0.157
35:	51.297	1.7796	51.298	1.7796	30	394	27.1	50	13.9	0.114
36:	52.816	1.7319	52.817	1.7319	28	185	12.7	31	8.6	0.151
37:	54.296	1.6882	54.298	1.6881	26	105	7.2	22	6.1	0.189
38:	55.016	1.6678	55.024	1.6676	28	303	20.9	58	16.1	0.172
39:	55.753	1.6475	55.754	1.6474	30	136	9.4	29	8.1	0.192
40:	56.498	1.6275	56.498	1.6275	30	86	5.9	7	1.9	0.073
41:	57.878	1.5919	57.875	1.5920	25	101	7.0	18	5.0	0.160
42:	58.598	1.5741	58.599	1.5741	24	137	9.4	16	4.4	0.105
43:	59.971	1.5413	59.974	1.5412	23	20	1.4	4	1.1	0.180

#	2Theta	d	2Theta	d	Bkgrd	Peak	I%	Area	I%	FWHM*
44:	60.652	1.5256	60.652	1.5256	23	82	5.6	13	3.6	0.143
45:	61.319	1.5106	61.328	1.5104	23	81	5.6	16	4.4	0.178
46:	62.019	1.4952	62.019	1.4952	23	112	7.7	9	2.5	0.072
47:	63.353	1.4669	63.357	1.4668	20	147	10.1	30	8.3	0.184
48:	64.014	1.4533	64.024	1.4531	19	65	4.5	14	3.9	0.194
49:	65.980	1.4147	65.980	1.4147	19	43	3.0	4	1.1	0.084
50:	66.134	1.4118	66.136	1.4117	20	50	3.4	4	1.1	0.072
51:	66.619	1.4027	66.619	1.4027	21	66	4.5	6	1.7	0.082
52:	67.241	1.3912	67.242	1.3912	23	51	3.5	6	1.7	0.106
53:	67.278	1.3905	67.278	1.3905	23	41	2.8	4	1.1	0.088
54:	68.552	1.3678	68.552	1.3678	24	76	5.2	16	4.4	0.189
55:	69.190	1.3567	69.194	1.3566	26	144	9.9	31	8.6	0.194

* Intensity values are based on total raw counts.

URANOPHANE SYNTHESIS

WRITTEN BY: J.D. Prikryl
REVISION NO.: 0

DATE WRITTEN: March 7, 1995
DATE REVISED:

OBJECTIVE: to synthesize uranophane [$Ca(UO_2)_2(SiO_3OH)_2.5H_2O$] for use in thermodynamic experiments of uranyl silicate minerals for the near-field geochemistry project.

EQUIPMENT:
Parr stainless steel reaction vessels (Model 4913EB; 2000 ml capacity)
Teflon liners for reaction vessels
Parr Model 4841 temperature controllers
Type J themocouples
ORION ph/mV/ISE/^{o}C meter
Combination ph electrode
Automatic termperature compensator probe
Analytical balance (Mettler PM 4600)
Welsh vacuum pump (Model 8910)
Hot plate (Thermolyne Type 13100)

SUPPLIES:
pH buffers (pH= 1,2,4)
ultrapure water
glassware and platicware as needed
1000 ml erlenmeyer flasks with stoppers
Fittings, valves, and tubing as necessary

REAGENTS:
Uranyl acetate dihydrate [$UO_2(CH_3COO_2.2H_2O$; MW=424.15 (lot 944231)
Sodium metasilicate nonahydrate [$Na_2SiO_3.9H_2O$; MW=284.20 (lot 942853A)
Calcium acetate monohydrate [$Ca(CH_3COO)_2.H_20$; MW=176.19
(lot 319617/1 194)
1 M HCl - diluted from lot 945500

PROCEDURE:

The procedure for uranophane synthesis is based on Cesbron et al., 1993. Reagents will be mixed in the stoichiometric ratio Ca:U:Si = 2:1:1. Although Cesbron et al. do not give information on the amount of solid and H_2O used, they state that good crystallinity is obtained if pH is less than 5.

a) Place 176 g Ca-acetate, 212 g U-acetate, and 142 g Na-metasilicate in a 2000 ml teflon liner and place liner in reaction vessel.

b) Cap and seal vessel and evacuate using a vacuum pump to remove $CO_2(g)$.

c) Transfer approximately 1000 ml of ultrapure H_2O to a 1000 ml erlenmeyer flask and lower pH of the fluid to 1.0 by dropwise addition of 1M HCl.

d) Degas the H_2O at a pH of 1.0 by boiling on a hotplate. After degassing cap erlenmeyer flask with a rubber stopper so that air cannot enter the flask.

e) After cooling record weight of the erlenmeyer flask with the degassed H2O.

f) Transfer approximately 500 g of the degassed H2O into the vessel by pulling in by vacuum. After the transfer, record weight of the erlenmeyer flask with remaining degassed H2O to determine actual weight of H2O introduced.

g) Raise and set the temperature of the solution in the reaction vessel to 150C using the temperature controller and allow the reaction to proceed for one week or longer.

Procedure for Uranophane Synthesis (based on Cesbron et al., 1993)

1. Reagents:
Uranyl acetate dihydrate [$UO_2(CH_3COO)_2.2H_2O$; MW=424.15]
Sodium metasilicate nonahydrate [$Na_2SiO_3.9H_2O$; MW=284.20]
Calcium acetate monohydrate [$Ca(CH_3COO)_2.H_2O$; MW=176.19]

2. Synthesis will be done at 150C using teflon-lined stainless-steel reaction vessel. Total volume capacity of the vessel is approximately 1750 ml. Three vessels and autoclaves are available for use. Two of the vessels have teflon lining; teflon lining will be purchased for the third vessel.

3. Reagents will be mixed in the stoichiometric ratio Ca:U:Si = 2:1:1. Cesbron et al. (1993) do not give information on amount of solid and H_2O used, and how pH was adjusted (trial and error?; final pH was measured presumably after solutions have cooled to room temperature). However, they stated that good crystallinity is obtained if pH is less than 5.

I propose to initially use 500 g H_2O, 176 g Ca-Ac, 212 g U-Ac, and 142 g Na-metasilicate. The solids will be placed inside the teflon-lined vessel, the vessel will be capped and subsequently evacuated to remove any $CO_2(g)$. Then 500 g of degassed H_2O (perhaps with pH lowered to 1.0 or lower by addition of HCl to compensate for any pH increase due to dissolution of the metasilicate) will be introduced into the vessel (pulled in by vacuum). The temperature will then be raised to 150C and the reaction allowed to occur for one week or longer.