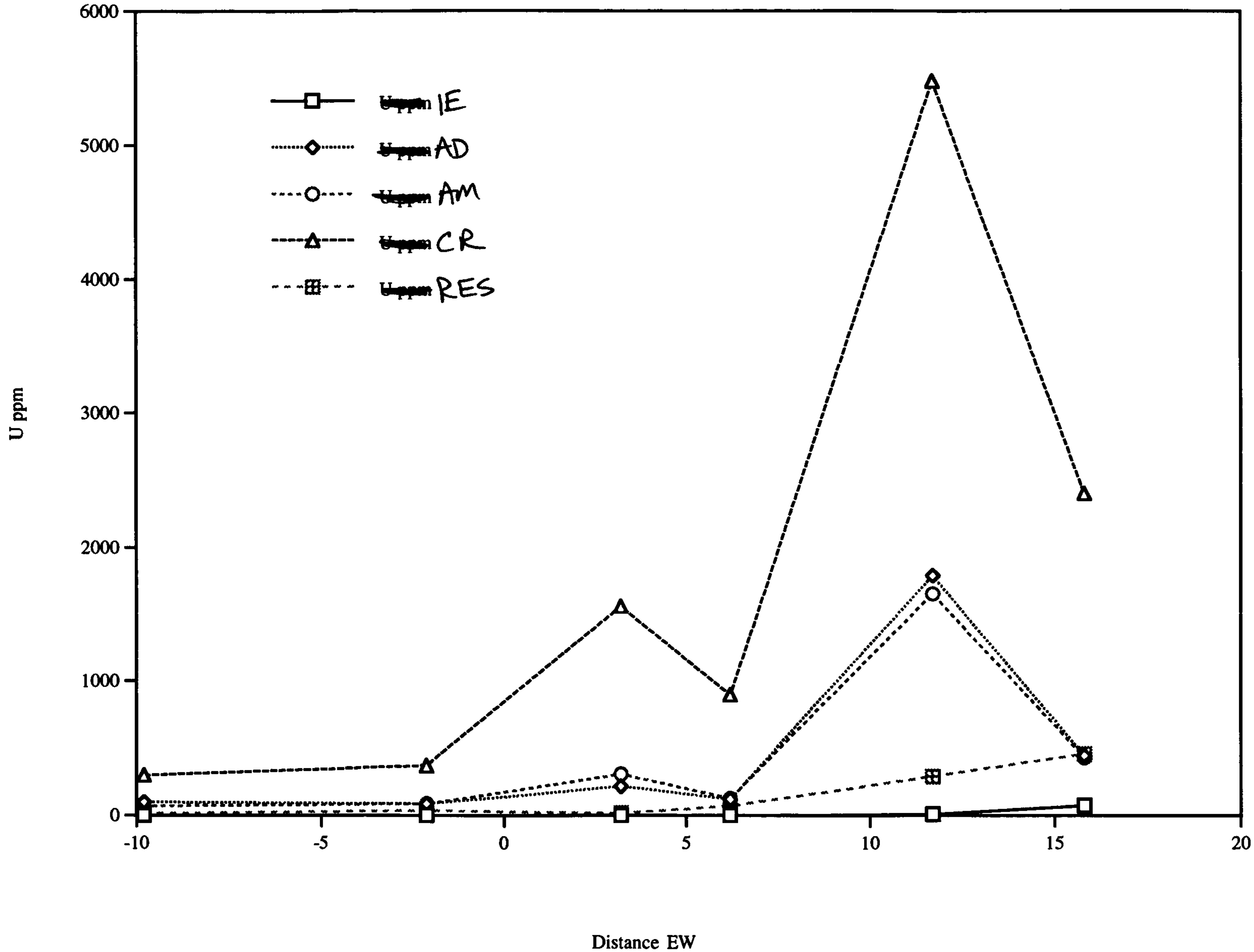
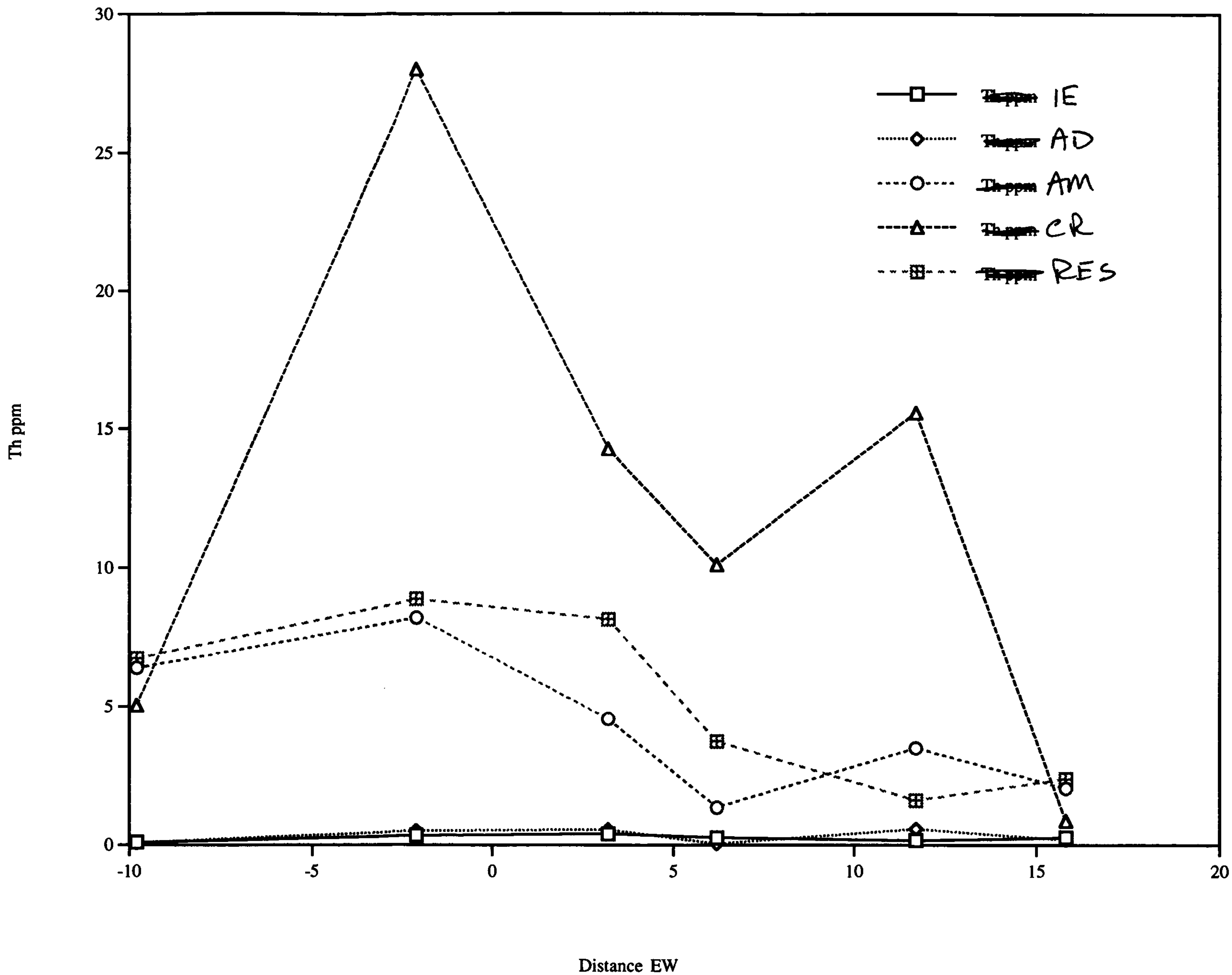
SEQUENTIAL EXTRACTIONS

NOPAL I SAMPLES

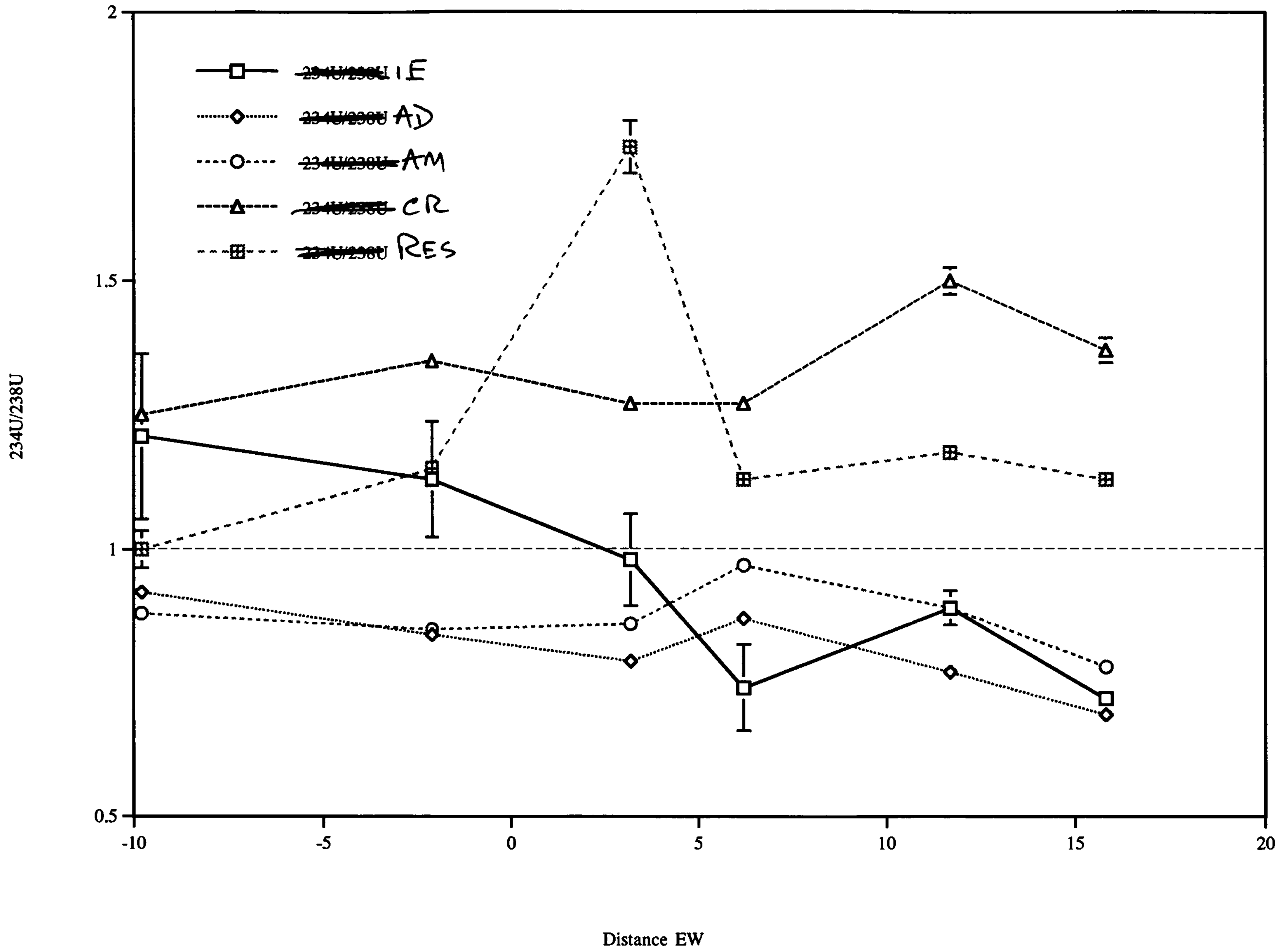
Sequential extraction of U and Th isotopes; 13.5 m N fracture.											
Sample No.	Distance EW	Total Sample Wt. (g)	Fraction	Wt. (g)	% of total wt.	U ppm	U ppm	Th ppm	Th ppm	234U/238U	230Th/234U
NOPI-417-PWD	15.8	2.6754				raw	based on % of total	raw	based on % of total		
			"IE" Ion exchangeable	0.037	1.382970771	5343.2	73.89489422	19.8	0.273828213	0.72	0.06
			"AD" Adsorbed	0.0154	0.575614861	76631	441.0994244	31.3	0.180167452	0.69	0.04
			"AM" Amorphous	0.1049	3.920909023	10909	427.7319653	52	2.038872692	0.78	1.28
			"CR" Crystalline	1.7616	65.84435972	3652.8	2405.162772	1.3	0.855976676	1.37	1.12
			"RES" Residue	0.7565	28.27614562	1608.8	454.9066308	8.4	2.375196232	1.13	1.3
			Totals	2.6754	100		3802.795687		5.724041265		
			Bulk	***0.7272***			***4369.1***		***14.06***	***1.03***	***1.09***
NOPI-418-PWD	11.7	2.5176									
			"IE" Ion exchangeable	0.0461	1.831108993	483.8	8.858905307	8.87	0.162419368	0.89	0.55
			"AD" Adsorbed	0.0236	0.937400699	191000	1790.435335	61.2	0.573689228	0.77	0.02
			"AM" Amorphous	0.1412	5.608516047	29480.8	1653.435399	62.35	3.496909755	0.89	1.25
			"CR" Crystalline	1.5004	59.59644105	9191.5	5477.80688	26.2	15.61426756	1.5	1.05
			"RES" Residue	0.8063	32.02653321	900.9	288.5270377	5	1.60132666	1.18	4.56
			Totals	2.5176	100		9219.063557		21.44861257		
			Bulk	***0.5744***			***8291.1***		***23.59***	***1.2***	***1.23***
NOPI-420-PWD	6.2	2.5294									
			"IE" Ion exchangeable	0.0121	0.478374318	255.4	1.221768008	54.3	0.259757255	0.74	0.97
			"AD" Adsorbed	0.0301	1.190005535	9930.7	118.1758797	3.18	0.037842176	0.87	0.04
			"AM" Amorphous	0.0483	1.909543765	6481.4	123.7651696	70.3	1.342409267	0.97	1.48
			"CR" Crystalline	1.2047	47.62789594	1871.7	891.4513284	21.267	10.12902463	1.27	1.14
			"RES" Residue	1.2342	48.79418044	143.5	70.01964893	7.66	3.737634222	1.13	1.19
			Totals	2.5294	100		1204.633795		15.50666755		
			Bulk	***0.7867***			***1302.9***		***28.03***	***1.1***	***1.26***
NOPI-421-PWD	3.2	2.4309									
			"IE" Ion exchangeable	0.0289	1.188860093	225.3	2.678501789	33.3	0.395890411	0.98	1.26
			"AD" Adsorbed	0.0107	0.440166194	49021	215.7738698	124.6	0.548447077	0.79	0.03
			"AM" Amorphous	0.0959	3.945040931	7746	305.5828705	115.4	4.552577235	0.86	1.59
			"CR" Crystalline	1.2876	52.96803653	2944	1559.378995	27	14.30136986	1.27	1.1
			"RES" Residue	1.0078	41.45789625	39.2	16.25149533	19.7	8.167205562	1.75	1.77
			Totals	2.4309	100		2099.665733		27.96549015		
			Bulk	***0.4513***			***2512***		***20.7***	***1.09***	***1.05***
NOPI-423-PWD	-2.1	2.5369									
			"IE" Ion exchangeable	0.0102	0.402065513	295.2	1.186897394	84.7	0.34054949	1.13	1.16
			"AD" Adsorbed	0.0237	0.934211045	9095	84.96649454	53.27	0.497654224	0.84	0.08
			"AM" Amorphous	0.0734	2.893294966	2924.8	84.62309117	283.96	8.215800386	0.85	1.63
			"CR" Crystalline	0.4088	16.11415507	2281.4	367.6283338	173.71	27.99189877	1.35	1.31
			"RES" Residue	2.0208	79.6562734	44.54	35.47890417	11.16	8.889640112	1.15	1.43
			Totals	2.5369	100		573.8837211		45.93554299		
			Bulk	***0.779***			***633.9***		***27.61***	***1.16***	***1.11***
NOPI-425-PWD	-9.8	2.5291									
			"IE" Ion exchangeable	0.0211	0.834288877	167.7	1.399102448	10.7	0.08926891	1.21	0.67
			"AD" Adsorbed	0.028	1.107113202	8898.8	98.51978965	7	0.077497924	0.92	0.08
			"AM" Amorphous	0.0432	1.708117512	3976.4	67.92158475	374.9	6.403732553	0.88	2.02
			"CR" Crystalline	1.2153	48.05266696	618.4	297.1576925	10.5	5.04553003	1.25	1.24
			"RES" Residue	1.2215	48.29781345	25.82	12.47049543	13.96	6.742374758	1	1.49
			Totals	2.5291	100		477.4686647		18.35840418		
			Bulk	***0.665***			***530.7***		***22.62***	***1.17***	***1***

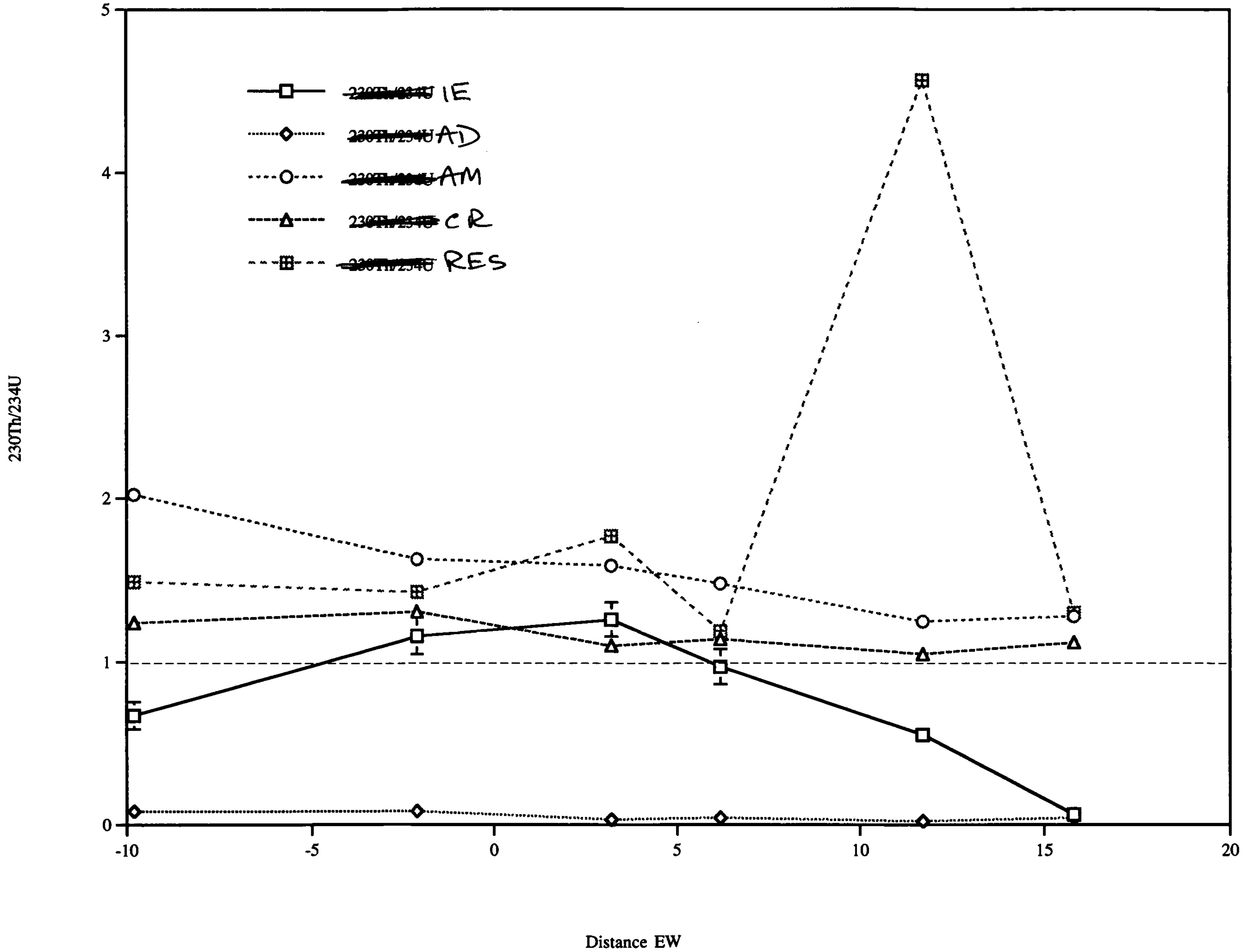


~~U ppm~~ IE
~~U ppm~~ AD
~~U ppm~~ AM
~~U ppm~~ CR
~~U ppm~~ RES
6000
5000
4000
3000
2000
1000
0
U ppm
-10
-5
0
5
10
15
20
Distance EW



~~Th ppm~~ IE
~~Th ppm~~ AD
~~Th ppm~~ AM
~~Th ppm~~ CR
~~Th ppm~~ RES
Th ppm
Distance EW
30
25
20
15
10
5
0
-10
-5
0
5
10
15
20


~~234U/238U~~ IE
~~234U/238U~~ AD
~~234U/238U~~ AM
~~234U/238U~~ CR
~~234U/238U~~ RES
234U/238U
2
1.5
1
0.5
-10
-5
0
5
10
15
20
Distance EW



5
4
3
2
1
0
-10
-5
0
5
10
15
20
230Th/234U
Distance EW
~~230Th/234U~~ IE
~~230Th/234U~~ AD
~~230Th/234U~~ AM
~~230Th/234U~~ CR
~~230Th/234U~~ RES

U and Th Isotope Activities

FILENAME= 417UIE.CHN
417THIE.CHN

3

Sample # **NOPI-417-PWD (IE)**
Analyst **JDP**

Sep. date **1/25/96**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.037	1.8731	454.83	1/22/93	1098	441.8557

Th-228/U-232= 0.7285164

Counting time for Th=	1271.1	(mins.)	Counting time for U=	833.33	(mins.)
Days btwn. sep. and count.=	4	(days)	Days btwn. sep. and count.=	4	(days)
CF for Th-228=	0.9956038		CF for U-232=	1.0041328	

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
14	496	44009	6907

U-238 counts	U-234 counts	U-232 counts
4800	3454	27042

Bkgd	Bkgd	Bkgd	bkgd
1	11	22	11

bkgd	bkgd	bkgd
2	3	6

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
13	485	43801.127	6896

U-238* counts	U-234* counts	U-232sp counts
4798	3451	26924.726

U-238(dpm/g)=	3986.104	±	62.43222
U-234(dpm/g)=	2867.037	±	51.8053
Th-232(dpm/g)=	4.836565	±	1.292832
Th-230(dpm/g)=	180.4411	±	8.147573
U-234/U-238=	0.719258	±	0.016049
Th-230/U-234=	0.062936	±	0.003022
Th-230/Th-232=	37.30769	±	10.11064
U234/Th-232=	592.7837	±	158.8149

Decay constant (m-1)	U-238	Th-232
	2.948E-16	9.413E-17

U(ppb)= 5343187

Th(ppb)= 19794.24

	Spike 25A 10/9/92	Spike 25B	Spide 25C
Th-228 (dpm/g)=	3222.4531	321.8991	32.172973

B

U and Th Isotope Activities

FILENAME= 417UAD.CHN
417THAD.CHN

Sample # **NOPI-417-PWD (AD)**
Analyst **JDP**

Sep. date **1/25/96**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.0154	1.9166	454.83	1/22/93	1098	441.8557

Th-228/U-232= 0.7285164

Counting time for Th= 1271.8 (mins.)
Days btwn. sep. and count.= 4 (days)
CF for Th-228= 0.9956036

Counting time for U= 1267.9 (mins.)
Days btwn. sep. and count.= 4 (days)
CF for U-232= 1.0042778

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
10	2103	47523	10103

U-238 counts	U-234 counts	U-232 counts
6331	4346	6134

Bkgd	Bkgd	Bkgd	bkgd
1	3	3	2

bkgd	bkgd	bkgd
2	7	20

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
9	2100	47183.124	10101

U-238* counts	U-234* counts	U-232sp counts
6329	4339	6087.9569

U-238(dpm/g)=	57168.23	±	1024.219
U-234(dpm/g)=	39193.07	±	777.0933
Th-232(dpm/g)=	7.641636	±	2.416752
Th-230(dpm/g)=	1783.048	±	39.73253
U-234/U-238=	0.685574	±	0.013505
Th-230/U-234=	0.045494	±	0.001208
Th-230/Th-232=	233.3333	±	73.9617
U234/Th-232=	5128.885	±	1625.251

Decay constant (m-1)	U-238	Th-232
	2.948E-16	9.413E-17

U(ppb)= 76631355

Th(ppb)= 31274.33

	Spike 25A 10/9/92	Spike 25B	Spide 25C
Th-228 (dpm/g)=	3222.4531	321.8991	32.172973

U and Th Isotope Activities

FILENAME= 417UAM.CHN
417THAM.CHN

Sample # **NOPI-417-PWD (AM)**
Analyst **JDP**

Sep. date **1/25/96**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.1049	0.9577	4553.22	1/22/93	1098	4423.336

Th-228/U-232= 0.7285119

Counting time for Th= 833.33 (mins.)
Days btwn. sep. and count.= 4 (days)
CF for Th-228= 0.9957539

Counting time for U= 1268.6 (mins.)
Days btwn. sep. and count.= 4 (days)
CF for U-232= 1.004278

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
74	46510	167325	25652
Bkgd	Bkgd	Bkgd	bkgd
2	16	3	1

U-238 counts	U-234 counts	U-232 counts
5441	4274	27130
bkgd	bkgd	bkgd
2	4	26

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
72	46494	166598.19	25651

U-238* counts	U-234* counts	U-232sp counts
5439	4270	26988.542

U-238(dpm/g)=	8138.486	±	120.8913
U-234(dpm/g)=	6389.287	±	105.1484
Th-232(dpm/g)=	12.7146	±	1.478369
Th-230(dpm/g)=	8210.455	±	43.0381
U-234/U-238=	0.785071	±	0.016046
Th-230/U-234=	1.285035	±	0.020539
Th-230/Th-232=	645.75	±	75.12661
U234/Th-232=	502.5157	±	59.01152

Decay constant (m-1)	U-238	Th-232
	2.948E-16	9.413E-17

U(ppb)= 10909262

Th(ppb)= 52036.08

	Spike 25A 10/9/92	Spike 25B	Spide 25C
Th-228 (dpm/g)=	3222.4531	321.8991	32.172973

A

U and Th Isotope Activities

FILENAME= 417UCR.CHN
417THCR.CHN

Sample # **NOPI-417-PWD (CR)**
Analyst **JDP**

Sep. date **1/25/96**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
1.7616	1.1739	4553.22	1/22/93	1098	4423.336

Th-228/U-232= 0.7285119

Counting time for Th= 500 (mins.)
Days btwn. sep. and count.= 4 (days)
CF for Th-228= 0.9958683

Counting time for U= 833.33 (mins.)
Days btwn. sep. and count.= 4 (days)
CF for U-232= 1.0041328

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
15	193802	99607	5468

U-238 counts	U-234 counts	U-232 counts
5948	8154	6471

Bkgd	Bkgd	Bkgd	bkgd
0	2	2	4

bkgd	bkgd	bkgd
4	6	15

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
15	193800	99712.456	5464

U-238* counts	U-234* counts	U-232sp counts
5944	8148	6429.4286

U-238(dpm/g)=	2725.086	±	48.94996
U-234(dpm/g)=	3735.532	±	62.19125
Th-232(dpm/g)=	0.323037	±	0.083414
Th-230(dpm/g)=	4173.638	±	16.27149
U-234/U-238=	1.370794	±	0.023374
Th-230/U-234=	1.117281	±	0.012631
Th-230/Th-232=	12920	±	3336.059
U234/Th-232=	11563.79	±	2992.182

Decay constant (m-1)	U-238	Th-232
	2.948E-16	9.413E-17

U(ppb)= 3652851

Th(ppb)= 1322.069

	Spike 25A 10/9/92	Spike 25B	Spide 25C
Th-228 (dpm/g)=	3222.4531	321.8991	32.172973

B

U and Th Isotope Activities

FILENAME= 417URES.CHN
417THRES.CHN

Sample # **NOPI-417-PWD (RES)**
Analyst **JDP**

Sep. date **1/25/96**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.7565	1.9119	454.83	1/22/93	1098	441.8557

Th-228/U-232= 0.7285164

Counting time for Th=	666.67	(mins.)	Counting time for U=	833.33	(mins.)
Days btwn. sep. and count.=	4	(days)	Days btwn. sep. and count.=	4	(days)
CF for Th-228=	0.9958111		CF for U-232=	1.0041328	

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
63	53117	24662	3022

U-238 counts	U-234 counts	U-232 counts
8299	9402	7761

Bkgd	Bkgd	Bkgd	bkgd
1	4	9	9

bkgd	bkgd	bkgd
3	5	10

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
62	53113	24534.343	3013

U-238* counts	U-234* counts	U-232sp counts
8296	9397	7719.0987

		±	
U-238(dpm/g)=	1200.159	±	18.95134
U-234(dpm/g)=	1359.438	±	20.84908
Th-232(dpm/g)=	2.055859	±	0.259344
Th-230(dpm/g)=	1761.175	±	13.57071
U-234/U-238=	1.132715	±	0.017061
Th-230/U-234=	1.295517	±	0.014495
Th-230/Th-232=	856.6613	±	107.9932
U234/Th-232=	661.2505	±	84.03028

Decay constant (m-1)	U-238	Th-232
	2.948E-16	9.413E-17

U(ppb)= 1608758

Th(ppb)= 8413.854

	Spike 25A 10/9/92	Spike 25B	Spide 25C
Th-228 (dpm/g)=	3222.4531	321.8991	32.172973

U and Th Isotope Activities

FILENAME= 418UIE.CHN
481THIE.CHN

Sample # **NOPI-418-PWD(IE)**
Analyst **JDP**

Sep. date **1/10/96**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.0461	0.5006	4553.22	1/22/93	1083	4425.085

Th-228/U-232= 0.7233834

Counting time for Th=	2398.55	(mins.)	Counting time for U=	2398.54	(mins.)
Days btwn. sep. and count.=	7	(days)	Days btwn. sep. and count.=	7	(days)
CF for Th-228=	0.9922599		CF for U-232=	1.0075329	

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
13	1008	193503	49157
Bkgd	Bkgd	Bkgd	bkgd
1	24	60	22

U-238 counts	U-234 counts	U-232 counts
1611	1437	215473
bkgd	bkgd	bkgd
5	7	57

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
12	984	192315.48	49135

U-238* counts	U-234* counts	U-232sp counts
1606	1430	213805.43

U-238(dpm/g)=	360.9428	±	9.026265
U-234(dpm/g)=	321.3874	±	8.506362
Th-232(dpm/g)=	2.168938	±	0.601575
Th-230(dpm/g)=	177.8529	±	5.616412
U-234/U-238=	0.890411	±	0.032309
Th-230/U-234=	0.553391	±	0.022736
Th-230/Th-232=	82	±	22.88889
U234/Th-232=	148.1773	±	41.28508

Decay constant (m-1)	U-238	Th-232
	2.948E-16	9.413E-17

U(ppb)= 483827.1

Th(ppb)= 8876.645

	Spike 25A 10/9/92	Spike 25B	Spide 25C
Th-228 (dpm/g)=	3201.0332	319.75941	31.959117

U and Th Isotope Activities

FILENAME= 418UAD2.CHN
418THAD2.CHN

Sample # **NOPI-418-PWD (AD)**
Analyst **JDP**

Sep. date **1/25/96**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.0236	0.4971	4553.22	1/22/93	1098	4423.336

Th-228/U-232= 0.7285119

Counting time for Th=	1270.5	(mins.)	Counting time for U=	1000	(mins.)
Days btwn. sep. and count.=	4	(days)	Days btwn. sep. and count.=	4	(days)
CF for Th-228=	0.995604		CF for U-232=	1.0041884	

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
19	3019	77606	13958

U-238 counts	U-234 counts	U-232 counts
2968	2288	1974

Bkgd	Bkgd	Bkgd	bkgd
2	3	12	5

bkgd	bkgd	bkgd
2	4	25

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
17	3016	77176.834	13953

U-238* counts	U-234* counts	U-232sp counts
2966	2284	1940.8709

U-238(dpm/g)=	142382.4	±	4135.253
U-234(dpm/g)=	109643.1	±	3368.11
Th-232(dpm/g)=	14.95135	±	3.430494
Th-230(dpm/g)=	2652.545	±	49.20604
U-234/U-238=	0.770061	±	0.021424
Th-230/U-234=	0.024193	±	0.000671
Th-230/Th-232=	177.4118	±	40.82892
U234/Th-232=	7333.324	±	1697.599

Decay constant (m-1)	U-238	Th-232
	2.948E-16	9.413E-17

U(ppb)= 1.91E+08

Th(ppb)= 61190.23

	Spike 25A 10/9/92	Spike 25B	Spide 25C
Th-228 (dpm/g)=	3222.4531	321.8991	32.172973

U and Th Isotope Activities

FILENAME= 418UAM2.CHN
418THAM2.CHN

Sample # **NOPI-418-PWD (AM)**
Analyst **JDP**

Sep. date **2/5/96**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.1412	0.9646	4553.22	1/22/93	1109	4422.054

Th-228/U-232= 0.732231

Counting time for Th= 500 (mins.)
Days btwn. sep. and count.= 2 (days)
CF for Th-228= 0.9978461

Counting time for U= 1073.42 (mins.)
Days btwn. sep. and count.= 2 (days)
CF for U-232= 1.0022884

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
32	49578	45275	6028
Bkgd	Bkgd	Bkgd	bkgd
1	14	14	10

U-238 counts	U-234 counts	U-232 counts
6074	5388	8383
bkgd	bkgd	bkgd
3	3	25

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
31	49564	45008.057	6018

U-238* counts	U-234* counts	U-232sp counts
6071	5385	8338.9174

	Value	±	Error
U-238(dpm/g)=	21993.14	±	370.5861
U-234(dpm/g)=	19508	±	340.6292
Th-232(dpm/g)=	15.23548	±	2.694229
Th-230(dpm/g)=	24359.08	±	158.348
U-234/U-238=	0.887004	±	0.0166
Th-230/U-234=	1.248671	±	0.017912
Th-230/Th-232=	1598.839	±	282.7286
U234/Th-232=	1280.432	±	227.5316

Decay constant (m-1)	U-238	Th-232
	2.948E-16	9.413E-17

U(ppb)= 29480779

Th(ppb)= 62353.07

	Spike 25A 10/9/92	Spike 25B	Spide 25C
Th-228 (dpm/g)=	3237.965	323.44862	32.327844

U and Th Isotope Activities

FILENAME= 418UCR.CHN
418THCR.CHN

Sample # **NOPI-418-PWD (CR)**

Sep. date **2/12/96**

Analyst **JDP**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
1.5004	2.859	4553.22	1/22/93	1116	4421.238

Th-228/U-232= 0.7345795

Counting time for Th= 833.33 (mins.)
Days btwn. sep. and count.= 2 (days)
CF for Th-228= 0.9977315

Counting time for U= 1083 (mins.)
Days btwn. sep. and count.= 2 (days)
CF for U-232= 1.0022916

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
209	352412	203132	25632

U-238 counts	U-234 counts	U-232 counts
5767	8650	7125

Bkgd	Bkgd	Bkgd	bkgd
0	3	7	23

bkgd	bkgd	bkgd
3	4	27

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
209	352409	202017.47	25609

U-238* counts	U-234* counts	U-232sp counts
5764	8646	7081.7715

U-238(dpm/g)=	6856.983	±	121.4579
U-234(dpm/g)=	10285.47	±	164.554
Th-232(dpm/g)=	6.402464	±	0.443095
Th-230(dpm/g)=	10795.63	±	30.0741
U-234/U-238=	1.5	±	0.0255
Th-230/U-234=	1.049599	±	0.011423
Th-230/Th-232=	1686.167	±	116.6692
U234/Th-232=	1606.487	±	114.1123

Decay constant (m-1)	U-238	Th-232
	2.948E-16	9.413E-17

U(ppb)= 9191468

Th(ppb)= 26202.87

	Spike 25A	Spike 25B	Spide 25C
	10/9/92		
Th-228 (dpm/g)=	3247.7508	324.42615	32.425545

U and Th Isotope Activities

FILENAME= 418URES.CHN
481THRES.CHN

Sample # **NOPI-418-PWD(RES)**
Analyst **JDP**

Sep. date **1/10/96**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.8063	0.4999	4553.22	1/22/93	1083	4425.085

Th-228/U-232= 0.7233834

Counting time for Th= 333.33 (mins.)
Days btwn. sep. and count.= 9 (days)
CF for Th-228= 0.9909978

Counting time for U= 2398.5 (mins.)
Days btwn. sep. and count.= 7 (days)
CF for U-232= 1.0075328

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
110	326230	179897	56997

Bkgd	Bkgd	Bkgd	bkgd
0	20	40	40

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
110	326210	178334.68	56957

U-238 counts	U-234 counts	U-232 counts
20003	23666	82308

bkgd	bkgd	bkgd
5	7	57

U-238* counts	U-234* counts	U-232sp counts
19998	23659	81636.048

U-238(dpm/g)=	672.0673	±	5.297919
U-234(dpm/g)=	795.1015	±	5.864605
Th-232(dpm/g)=	1.224147	±	0.116754
Th-230(dpm/g)=	3630.263	±	10.6609
U-234/U-238=	1.183068	±	0.011363
Th-230/U-234=	4.565786	±	0.030737
Th-230/Th-232=	2965.545	±	282.8013
U234/Th-232=	649.5147	±	62.1327

Decay constant (m-1)	U-238	Th-232
	2.948E-16	9.413E-17

U(ppb)= 900875

Th(ppb)= 5009.972

	Spike 25A 10/9/92	Spike 25B	Spide 25C
Th-228 (dpm/g)=	3201.0332	319.75941	31.959117

U and Th Isotope Activities

FILENAME= 418ieu3.chn
418ieth3.chn

Sample # **NOPI-418-PWD (IE)**
Analyst **JDP**

Sep. date **5/21/96**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.0294	1.0046	454.83	1/22/93	1215	440.4952

Th-228/U-232= 0.7663343

Counting time for Th=	1461.3	(mins.)
Days btwn. sep. and count.=	56	(days)
CF for Th-228=	0.9454858	

Counting time for U=	1465.4	(mins.)
Days btwn. sep. and count.=	56	(days)
CF for U-232=	1.0529863	

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
14	916	23096	15833
Bkgd	Bkgd	Bkgd	bkgd
5	30	6	1
Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
9	886	23524.832	15832

U-238 counts	U-234 counts	U-232 counts
1360	1303	33342
bkgd	bkgd	bkgd
3	3	20
U-238* counts	U-234* counts	U-232sp counts
1357	1300	31645.237

		±	
U-238(dpm/g)=	645.4439	±	17.85544
U-234(dpm/g)=	618.3324	±	17.46121
Th-232(dpm/g)=	4.412871	±	1.179747
Th-230(dpm/g)=	434.4226	±	14.6356
U-234/U-238=	0.957996	±	0.037137
Th-230/U-234=	0.702571	±	0.030293
Th-230/Th-232=	98.44444	±	26.51068
U234/Th-232=	140.1202	±	37.66845

Decay constant (m-1)	U-238	Th-232
	2.948E-16	9.413E-17

U(ppb)= 865187.6

Th(ppb)= 18060.22

	Spike 25A 10/9/92	Spike 25B	Spide 25C
Th-228 (dpm/g)=	3379.2962	337.56656	33.738894

U and Th Isotope Activities

FILENAME= 418UAD3.CHN
418THAD3.CHN

Sample # **NOPI-418-PWD (AD)**
Analyst **JDP**

Sep. date **5/27/96**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.0395	0.8467	4553.22	1/22/93	1221	4409.019

Th-228/U-232= 0.768169

Counting time for Th= 500 (mins.)
Days btwn. sep. and count.= 52 (days)
CF for Th-228= 0.9495594

Counting time for U= 1466.2 (mins.)
Days btwn. sep. and count.= 51 (days)
CF for U-232= 1.0484236

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
5	14477	55749	49474

U-238 counts	U-234 counts	U-232 counts
4715	3534	7218

Bkgd	Bkgd	Bkgd	bkgd
1	6	16	6

bkgd	bkgd	bkgd
8	10	30

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
4	14471	55928.466	49468

U-238* counts	U-234* counts	U-232sp counts
4707	3524	6856.0072

U-238(dpm/g)=	64885.46	±	1214.991
U-234(dpm/g)=	48577.94	±	997.3372
Th-232(dpm/g)=	5.192282	±	2.322163
Th-230(dpm/g)=	18784.38	±	175.2217
U-234/U-238=	0.748672	±	0.016658
Th-230/U-234=	0.386685	±	0.007255
Th-230/Th-232=	3617.75	±	1618.186
U234/Th-232=	9355.797	±	4188.634

Decay constant (m-1)	U-238	Th-232
	2.948E-16	9.413E-17

U(ppb)= 86975950

Th(ppb)= 21250.05

	Spike 25A 10/9/92	Spike 25B	Spide 25C
Th-228 (dpm/g)=	3386.8718	338.3233	33.814529

U and Th Isotope Activities

FILENAME= 418UAM3.CHN
418THAM3.CHN

Sample # **NOPI-418-PWD (AM)**
Analyst **JDP**

Sep. date **5/27/96**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.1509	1.0001	4553.22	1/22/93	1221	4409.019

Th-228/U-232= 0.768169

Counting time for Th=	500	(mins.)
Days btwn. sep. and count.=	52	(days)
CF for Th-228=	0.9495594	

Counting time for U=	1466.8	(mins.)
Days btwn. sep. and count.=	51	(days)
CF for U-232=	1.0484238	

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
22	53808	61571	53284
Bkgd	Bkgd	Bkgd	bkgd
2	24	25	15

U-238 counts	U-234 counts	U-232 counts
114	39	14184
bkgd	bkgd	bkgd
4	5	14

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
20	53784	61822.098	53269

U-238* counts	U-234* counts	U-232sp counts
110	34	13515.527

		±	
U-238(dpm/g)=	237.8241	±	22.3636
U-234(dpm/g)=	73.50927	±	11.78708
Th-232(dpm/g)=	7.261715	±	1.548479
Th-230(dpm/g)=	19528.2	±	115.2429
U-234/U-238=	0.309091	±	0.057339
Th-230/U-234=	265.6563	±	42.55447
Th-230/Th-232=	2689.2	±	573.4566
U234/Th-232=	10.12285	±	2.700779

Decay constant (m-1)	U-238	Th-232
	2.948E-16	9.413E-17

U(ppb)= 318792.2

Th(ppb)= 29719.46

	Spike 25A	Spike 25B	Spide 25C
	10/9/92		
Th-228 (dpm/g)=	3386.8718	338.3233	33.814529

U and Th Isotope Activities

FILENAME= 418UCR3.CHN
418THCR3.CHN

Sample # **NOPI-418-PWD (CR)**
Analyst **JDP**

Sep. date **6/19/96**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
2.1807	0.9708	4553.22	1/22/93	1244	4406.347

Th-228/U-232= 0.7751337

Counting time for Th=	500	(mins.)
Days btwn. sep. and count.=	29	(days)
CF for Th-228=	0.971474	

Counting time for U=	666.67	(mins.)
Days btwn. sep. and count.=	28	(days)
CF for U-232=	1.0268635	

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
135	501501	99146	88815
Bkgd	Bkgd	Bkgd	bkgd
1	7	4	3

U-238 counts	U-234 counts	U-232 counts
6178	10041	2852
bkgd	bkgd	bkgd
40	45	25

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
134	501494	97073.919	88812

U-238* counts	U-234* counts	U-232sp counts
6138	9996	2753.0437

		±	
U-238(dpm/g)=	4373.472	±	99.00828
U-234(dpm/g)=	7122.389	±	151.1261
Th-232(dpm/g)=	2.098898	±	0.180767
Th-230(dpm/g)=	7855.112	±	27.30163
U-234/U-238=	1.628543	±	0.026333
Th-230/U-234=	1.102876	±	0.011116
Th-230/Th-232=	3742.493	±	322.1458
U234/Th-232=	3393.394	±	300.9946

Decay constant (m-1)	U-238	Th-232
	2.948E-16	9.413E-17

U(ppb)= 5862436

Th(ppb)= 8590

	Spike 25A 10/9/92	Spike 25B	Spide 25C
Th-228 (dpm/g)=	3415.5082	341.18387	34.100435

U and Th Isotope Activities

FILENAME= 418resu3.chn
418rth3.chn

Sample # **NOPI-418-PWD (RES)**
Analyst **JDP**

Sep. date **5/21/96**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.1061	1.0129	454.83	1/22/93	1215	440.4952

Th-228/U-232= 0.7663343

Counting time for Th=	1000	(mins.)
Days btwn. sep. and count.=	52	(days)
CF for Th-228=	0.9493958	

Counting time for U=	1468.2	(mins.)
Days btwn. sep. and count.=	51	(days)
CF for U-232=	1.0484243	

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
0	1303	19289	11987

U-238 counts	U-234 counts	U-232 counts
917	1077	27865

Bkgd	Bkgd	Bkgd	bkgd
0	30	10	1

bkgd	bkgd	bkgd
22	20	45

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
0	1273	19637.48	11986

U-238* counts	U-234* counts	U-232sp counts
895	1057	26535.059

U-238(dpm/g)=	141.8389	±	4.76038
U-234(dpm/g)=	167.5125	±	5.202046
Th-232(dpm/g)=	0	±	#DIV/0!
Th-230(dpm/g)=	208.9071	±	5.979646
U-234/U-238=	1.181006	±	0.053067
Th-230/U-234=	1.247114	±	0.051359
Th-230/Th-232=	#DIV/0!	±	#DIV/0!
U234/Th-232=	#DIV/0!	±	#DIV/0!

Decay constant (m-1)	U-238	Th-232
	2.948E-16	9.413E-17

U(ppb)= 190128.4

Th(ppb)= 0

	Spike 25A 10/9/92	Spike 25B	Spide 25C
Th-228 (dpm/g)=	3379.2962	337.56656	33.738894

U and Th Isotope Activities

FILENAME= 420UIE.CHN
420THIE.CHN

B

Sample # **NOPI-420-PWD (IE)**
Analyst **JDP**

Sep. date **2/7/96**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.0121	1.9157	454.83	1/22/93	1111	441.7043

Th-228/U-232= 0.732908

Counting time for Th=	2166.67	(mins.)
Days btwn. sep. and count.=	2	(days)
CF for Th-228=	0.9972735	

Counting time for U=	2083.33	(mins.)
Days btwn. sep. and count.=	2	(days)
CF for U-232=	1.002626	

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
19	171	58456	11751
Bkgd	Bkgd	Bkgd	bkgd
4	15	49	18

U-238 counts	U-234 counts	U-232 counts
196	149	71398
bkgd	bkgd	bkgd
2	5	11

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
15	156	57928.135	11733

U-238* counts	U-234* counts	U-232sp counts
194	144	71200.026

U-238(dpm/g)=	190.544	±	13.62896
U-234(dpm/g)=	141.4347	±	11.59887
Th-232(dpm/g)=	13.27165	±	3.04522
Th-230(dpm/g)=	138.0252	±	10.57047
U-234/U-238=	0.742268	±	0.080677
Th-230/U-234=	0.975893	±	0.109367
Th-230/Th-232=	10.4	±	2.514984
U234/Th-232=	10.65691	±	2.596747

Decay constant (m-1)	U-238	Th-232
	2.948E-16	9.413E-17

U(ppb)= 255415.4

Th(ppb)= 54315.86

	Spike 25A 10/9/92	Spike 25B	Spide 25C
Th-228 (dpm/g)=	3240.7677	323.72859	32.355826

U and Th Isotope Activities

FILENAME= 420UAD.CHN
420THAD.CHN

Sample # **NOPI-420-PWD (AD)**
Analyst **JDP**

Sep. date **2/7/96**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.0301	1.998	454.83	1/22/93	1111	441.7043

Th-228/U-232= 0.732908

Counting time for Th=	2000	(mins.)	Counting time for U=	1250	(mins.)
Days btwn. sep. and count.=	2	(days)	Days btwn. sep. and count.=	2	(days)
CF for Th-228=	0.9973307		CF for U-232=	1.0023474	

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
4	1000	83504	14145

U-238 counts	U-234 counts	U-232 counts
13748	12016	54548

Bkgd	Bkgd	Bkgd	bkgd
1	7	4	2

bkgd	bkgd	bkgd
2	7	19

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
3	993	82968.897	14143

U-238* counts	U-234* counts	U-232sp counts
13746	12009	54401.297

U-238(dpm/g)=	7408.456	±	70.69947
U-234(dpm/g)=	6472.293	±	65.22417
Th-232(dpm/g)=	0.776991	±	0.388505
Th-230(dpm/g)=	257.184	±	8.181425
U-234/U-238=	0.873636	±	0.01091
Th-230/U-234=	0.039736	±	0.001308
Th-230/Th-232=	331	±	165.8307
U234/Th-232=	8329.947	±	4165.919

Decay constant (m-1)	U-238	Th-232
	2.948E-16	9.413E-17

U(ppb)= 9930691

Th(ppb)= 3179.931

	Spike 25A 10/9/92	Spike 25B	Spide 25C
Th-228 (dpm/g)=	3240.7677	323.72859	32.355826

U and Th Isotope Activities

FILENAME= 420UAM.CHN
420THAM.CHN

Sample # **NOPI-420-PWD (AM)**
Analyst **JDP**

Sep. date **2/7/96**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.0483	1.0006	4553.22	1/22/93	1111	4421.821

Th-228/U-232= 0.7329034

Counting time for Th= 1166.67 (mins.)
Days btwn. sep. and count.= 2 (days)
CF for Th-228= 0.997617

Counting time for U= 1333.33 (mins.)
Days btwn. sep. and count.= 2 (days)
CF for U-232= 1.0023753

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
61	23660	228123	36155

U-238 counts	U-234 counts	U-232 counts
11410	11144	216623

Bkgd	Bkgd	Bkgd	bkgd
3	22	8	1

bkgd	bkgd	bkgd
4	5	21

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
58	23638	226681.16	36154

U-238* counts	U-234* counts	U-232sp counts
11406	11139	216088.73

U-238(dpm/g)=	4835.215	±	46.44292
U-234(dpm/g)=	4722.029	±	45.86709
Th-232(dpm/g)=	17.17805	±	2.199718
Th-230(dpm/g)=	7000.943	±	47.81651
U-234/U-238=	0.976591	±	0.013007
Th-230/U-234=	1.482613	±	0.017034
Th-230/Th-232=	407.5517	±	52.24888
U234/Th-232=	274.8874	±	35.30155

Decay constant (m-1)	U-238	Th-232
	2.948E-16	9.413E-17

U(ppb)= 6481381

Th(ppb)= 70303.28

	Spike 25A 10/9/92	Spike 25B	Spide 25C
Th-228 (dpm/g)=	3240.7677	323.72859	32.355826

U and Th Isotope Activities

FILENAME= 420UCR.CHN
420THCR.CHN

Sample # **NOPI-420-PWD (CR)**
Analyst **JDP**

Sep. date **2/7/96**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
1.2047	1.5059	4553.22	1/22/93	1111	4421.821

Th-228/U-232= 0.7329034

Counting time for Th=	833.33	(mins.)
Days btwn. sep. and count.=	2	(days)
CF for Th-228=	0.9977315	

Counting time for U=	1333.33	(mins.)
Days btwn. sep. and count.=	2	(days)
CF for U-232=	1.0023753	

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
200	78197	156709	17860

U-238 counts	U-234 counts	U-232 counts
8250	10481	32733

Bkgd	Bkgd	Bkgd	bkgd
0	3	7	24

bkgd	bkgd	bkgd
7	9	25

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
200	78194	155910.83	17836

U-238* counts	U-234* counts	U-232sp counts
8243	10472	32630.493

		±	
U-238(dpm/g)=	1396.304	±	17.20133
U-234(dpm/g)=	1773.881	±	19.90867
Th-232(dpm/g)=	5.196595	±	0.367689
Th-230(dpm/g)=	2031.713	±	8.895438
U-234/U-238=	1.270411	±	0.018698
Th-230/U-234=	1.145349	±	0.011914
Th-230/Th-232=	390.97	±	27.68109
U234/Th-232=	341.3544	±	24.45476

Decay constant (m-1)	U-238	Th-232
	2.948E-16	9.413E-17

U(ppb)= 1871681

Th(ppb)= 21267.7

	Spike 25A 10/9/92	Spike 25B	Spide 25C
Th-228 (dpm/g)=	3240.7677	323.72859	32.355826

U and Th Isotope Activities

FILENAME= 420URES.CHN
420THRES.CHN

Sample # **NOPI-420-PWD (RES)**
Analyst **JDP**

Sep. date **2/7/96**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
1.2342	1.843	454.83	1/22/93	1111	441.7043

Th-228/U-232= 0.732908

Counting time for Th=	1333.33	(mins.)	Counting time for U=	1333.33	(mins.)
Days btwn. sep. and count.=	2	(days)	Days btwn. sep. and count.=	2	(days)
CF for Th-228=	0.9975597		CF for U-232=	1.0023753	

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
170	13115	44303	6677

U-238 counts	U-234 counts	U-232 counts
9775	11075	60361

Bkgd	Bkgd	Bkgd	bkgd
0	0	8	36

bkgd	bkgd	bkgd
5	8	16

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
170	13115	43880.523	6641

U-238* counts	U-234* counts	U-232sp counts
9770	11067	60202.003

U-238(dpm/g)=	107.0422	±	1.167049
U-234(dpm/g)=	121.2524	±	1.253426
Th-232(dpm/g)=	1.872828	±	0.143915
Th-230(dpm/g)=	144.4832	±	1.436285
U-234/U-238=	1.132753	±	0.01572
Th-230/U-234=	1.19159	±	0.015378
Th-230/Th-232=	77.14706	±	5.955134
U234/Th-232=	64.74294	±	5.019889

Decay constant (m-1)	U-238	Th-232
	2.948E-16	9.413E-17

U(ppb)= 143485.1

Th(ppb)= 7664.78

	Spike 25A 10/9/92	Spike 25B	Spide 25C
Th-228 (dpm/g)=	3240.7677	323.72859	32.355826

U and Th Isotope Activities

FILENAME= 421UIE.CHN
421THIE.CHN

Sample # **NOPI-421-PWD (IE)**
Analyst **JDP**

Sep. date **2/8/96**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.0289	1.8716	454.83	1/22/93	1112	441.6927

Th-228/U-232= 0.7332437

Counting time for Th= 1073.8 (mins.)
Days btwn. sep. and count.= 5 (days)
CF for Th-228= 0.9946842

Counting time for U= 1077.02 (mins.)
Days btwn. sep. and count.= 5 (days)
CF for U-232= 1.0051749

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
15	341	33701	6000

U-238 counts	U-234 counts	U-232 counts
262	259	44506

Bkgd	Bkgd	Bkgd	bkgd
2	11	12	10

bkgd	bkgd	bkgd
2	5	28

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
13	330	33536.873	5990

U-238* counts	U-234* counts	U-232sp counts
260	254	44249.018

U-238(dpm/g)=	168.0758	±	10.41427
U-234(dpm/g)=	164.1971	±	10.23235
Th-232(dpm/g)=	8.130262	±	2.099692
Th-230(dpm/g)=	206.3836	±	11.2327
U-234/U-238=	0.976923	±	0.085601
Th-230/U-234=	1.256926	±	0.1036
Th-230/Th-232=	25.38462	±	6.696884
U234/Th-232=	20.19579	±	5.365389

Decay	U-238	Th-232
constant (m-1)	2.948E-16	9.413E-17

U(ppb)= 225297.8

Th(ppb)= 33274.09

	Spike 25A 10/9/92	Spike 25B	Spide 25C
Th-228 (dpm/g)=	3242.167	323.86837	32.369797

U and Th Isotope Activities

FILENAME= 421UAD.CHN
421THAD.CHN

Sample # **NOPI-421-PWD (AD)**
Analyst **JDP**

Sep. date **2/8/96**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.0107	1.9218	454.83	1/22/93	1112	441.6927

Th-228/U-232= 0.7332437

Counting time for Th= 1074.5 (mins.)
Days btwn. sep. and count.= 5 (days)
CF for Th-228= 0.994684

Counting time for U= 1077.6 (mins.)
Days btwn. sep. and count.= 5 (days)
CF for U-232= 1.0051751

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
23	703	42197	6597
Bkgd	Bkgd	Bkgd	bkgd
1	3	3	1

U-238 counts	U-234 counts	U-232 counts
8135	6409	17740
bkgd	bkgd	bkgd
2	5	6

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
22	700	42046.046	6596

U-238* counts	U-234* counts	U-232sp counts
8133	6404	17642.698

U-238(dpm/g)=	36570.45	±	489.6829
U-234(dpm/g)=	28795.92	±	419.6706
Th-232(dpm/g)=	30.4362	±	6.348116
Th-230(dpm/g)=	968.4246	±	36.82782
U-234/U-238=	0.787409	±	0.013151
Th-230/U-234=	0.033631	±	0.001336
Th-230/Th-232=	31.81818	±	6.742207
U234/Th-232=	946.1074	±	197.8119

Decay constant (m-1)	U-238	Th-232
	2.948E-16	9.413E-17

U(ppb)= 49020997

Th(ppb)= 124563.9

	Spike 25A 10/9/92	Spike 25B	Spide 25C
Th-228 (dpm/g)=	3242.167	323.86837	32.369797

U and Th Isotope Activities

FILENAME= 421UAM.CHN
421THAM.CHN

Sample # **NOPI-421-PWD (AM)**
Analyst **JDP**

Sep. date **2/8/96**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.0959	0.9435	4553.22	1/22/93	1112	4421.704

Th-228/U-232= 0.7332392

Counting time for Th= 833.33 (mins.)
Days btwn. sep. and count.= 5 (days)
CF for Th-228= 0.9947666

Counting time for U= 1078.1 (mins.)
Days btwn. sep. and count.= 5 (days)
CF for U-232= 1.0051752

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
156	42539	172581	27079

U-238 counts	U-234 counts	U-232 counts
7154	6157	54134

Bkgd	Bkgd	Bkgd	bkgd
4	19	3	1

bkgd	bkgd	bkgd
2	6	16

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
152	42520	171891.23	27078

U-238* counts	U-234* counts	U-232sp counts
7152	6151	53839.369

U-238(dpm/g)=	5778.838	±	72.69738
U-234(dpm/g)=	4970.027	±	66.84445
Th-232(dpm/g)=	28.20646	±	2.259344
Th-230(dpm/g)=	7890.385	±	42.71186
U-234/U-238=	0.860039	±	0.014951
Th-230/U-234=	1.587594	±	0.021648
Th-230/Th-232=	279.7368	±	22.4379
U234/Th-232=	176.2018	±	14.31138

Decay constant (m-1)	U-238	Th-232
	2.948E-16	9.413E-17

U(ppb)= 7746265

Th(ppb)= 115438.4

	Spike 25A 10/9/92	Spike 25B	Spide 25C
Th-228 (dpm/g)=	3242.167	323.86837	32.369797

U and Th Isotope Activities

FILENAME= 421UCR.CHN
421THCR.CHN

Sample # **NOPI-421-PWD (CR)**
Analyst **JDP**

Sep. date **2/8/96**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
1.2876	1.1321	4553.22	1/22/93	1112	4421.704

Th-228/U-232= 0.7332392

Counting time for Th=	833.33	(mins.)
Days btwn. sep. and count.=	5	(days)
CF for Th-228=	0.9947666	

Counting time for U=	1078.6	(mins.)
Days btwn. sep. and count.=	5	(days)
CF for U-232=	1.0051754	

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
423	197756	183738	25271

U-238 counts	U-234 counts	U-232 counts
7379	9387	13136

Bkgd	Bkgd	Bkgd	bkgd
0	3	6	27

bkgd	bkgd	bkgd
3	4	15

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
423	197753	182930.63	25244

U-238* counts	U-234* counts	U-232sp counts
7376	9383	13053.443

		±	
U-238(dpm/g)=	2196.794	±	31.95912
U-234(dpm/g)=	2794.539	±	37.76837
Th-232(dpm/g)=	6.591635	±	0.320865
Th-230(dpm/g)=	3081.597	±	9.985168
U-234/U-238=	1.272099	±	0.019791
Th-230/U-234=	1.102721	±	0.011649
Th-230/Th-232=	467.5012	±	22.75498
U234/Th-232=	423.9523	±	21.41763

Decay constant (m-1)	U-238	Th-232
	2.948E-16	9.413E-17

U(ppb)= 2944701

Th(ppb)= 26977.08

	Spike 25A 10/9/92	Spike 25B	Spide 25C
Th-228 (dpm/g)=	3242.167	323.86837	32.369797

U and Th Isotope Activities

FILENAME= 421URES.CHN
421THRES.CHN

Sample # **NOPI-421-PWD (RES)**
Analyst **JDP**

Sep. date **2/8/96**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
1.0078	1.8877	454.83	1/22/93	1112	441.6927

Th-228/U-232= 0.7332437

Counting time for Th=	1076.3	(mins.)	Counting time for U=	1079	(mins.)
Days btwn. sep. and count.=	5	(days)	Days btwn. sep. and count.=	5	(days)
CF for Th-228=	0.9946834		CF for U-232=	1.0051755	

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
218	4066	27534	5680

U-238 counts	U-234 counts	U-232 counts
1990	3478	56421

Bkgd	Bkgd	Bkgd	bkgd
2	6	13	13

bkgd	bkgd	bkgd
5	7	18

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
216	4060	27150.145	5667

U-238* counts	U-234* counts	U-232sp counts
1985	3471	56112.588

		±	
U-238(dpm/g)=	29.26705	±	0.667543
U-234(dpm/g)=	51.1768	±	0.894124
Th-232(dpm/g)=	4.826238	±	0.328166
Th-230(dpm/g)=	90.71541	±	1.524075
U-234/U-238=	1.748615	±	0.049149
Th-230/U-234=	1.772589	±	0.040941
Th-230/Th-232=	18.7963	±	1.306728
U234/Th-232=	10.60387	±	0.744443

Decay constant (m-1)	U-238	Th-232
	2.948E-16	9.413E-17

U(ppb)= 39231.13

Th(ppb)= 19751.97

	Spike 25A 10/9/92	Spike 25B	Spide 25C
Th-228 (dpm/g)=	3242.167	323.86837	32.369797

U and Th Isotope Activities

FILENAME= 423UIE2.CHN
423THIE2.CHN

Sample # **NOPI-423-PWD(IE)**
Analyst **JDP**

Sep. date **2/7/96**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.0102	0.5064	454.83	1/22/93	1111	441.7043

Th-228/U-232= 0.732908

Counting time for Th= 2500 (mins.)
Days btwn. sep. and count.= 2 (days)
CF for Th-228= 0.997159

Counting time for U= 2083.33 (mins.)
Days btwn. sep. and count.= 2 (days)
CF for U-232= 1.002626

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
16	188	10214	2063

U-238 counts	U-234 counts	U-232 counts
211	242	20821

Bkgd	Bkgd	Bkgd	bkgd
3	6	24	9

bkgd	bkgd	bkgd
3	6	53

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
13	182	10096.86	2054

U-238* counts	U-234* counts	U-232sp counts
208	236	20713.605

		±	
U-238(dpm/g)=	220.2078	±	15.23635
U-234(dpm/g)=	249.8512	±	16.15411
Th-232(dpm/g)=	20.69339	±	5.177397
Th-230(dpm/g)=	289.7074	±	21.32265
U-234/U-238=	1.134615	±	0.106868
Th-230/U-234=	1.15952	±	0.112726
Th-230/Th-232=	14	±	3.645895
U234/Th-232=	12.07396	±	3.12009

Decay constant (m-1)	U-238	Th-232
	2.948E-16	9.413E-17

U(ppb)= 295178.4

Th(ppb)= 84690.23

	Spike 25A 10/9/92	Spike 25B	Spide 25C
Th-228 (dpm/g)=	3240.7677	323.72859	32.355826

U and Th Isotope Activities

FILENAME= 423UIE.CHN
423THIE.CHN

Sample # **NOPI-423-PWD(IE)**
Analyst **JDP**

Sep. date **1/10/96**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.0102	0.5064	454.83	1/22/93	1083	442.0304

Th-228/U-232= 0.7233878

Counting time for Th= 7067.85 (mins.)
Days btwn. sep. and count.= 1 (days)
CF for Th-228= 0.9965803

Counting time for U= 2398.5 (mins.)
Days btwn. sep. and count.= 7 (days)
CF for U-232= 1.0075328

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
0	0	0	0

U-238 counts	U-234 counts	U-232 counts
293	228	27395

Bkgd	Bkgd	Bkgd	bkgd
0	8	19	30

bkgd	bkgd	bkgd
7	8	25

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
0	-8	-17.46974	-30

U-238* counts	U-234* counts	U-232sp counts
286	220	27165.367

		±	
U-238(dpm/g)=	231.0448	±	13.56977
U-234(dpm/g)=	177.7267	±	11.81912
Th-232(dpm/g)=	0	±	#DIV/0!
Th-230(dpm/g)=	7269.765	±	#DIV/0!
U-234/U-238=	0.769231	±	0.067932
Th-230/U-234=	40.90417	±	#DIV/0!
Th-230/Th-232=	#DIV/0!	±	#DIV/0!
U234/Th-232=	#DIV/0!	±	#DIV/0!

Decay constant (m-1)	U-238	Th-232
	2.948E-16	9.413E-17

U(ppb)= 309704.8

Th(ppb)= 0

	Spike 25A 10/9/92	Spike 25B	Spide 25C
Th-228 (dpm/g)=	3201.0332	319.75941	31.959117

U and Th Isotope Activities

FILENAME= 423UAD.CHN
423THAD.CHN

Sample # **NOPI-423-PWD(AD)**
Analyst **JDP**

Sep. date **1/10/96**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.0237	0.5014	454.83	1/22/93	1083	442.0304

Th-228/U-232= 0.7233878

Counting time for Th= 3333.33 (mins.)
Days btwn. sep. and count.= 9 (days)
CF for Th-228= 0.9899745

Counting time for U= 2398.5 (mins.)
Days btwn. sep. and count.= 7 (days)
CF for U-232= 1.0075328

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
68	2368	35681	21343

U-238 counts	U-234 counts	U-232 counts
14244	12023	19700

Bkgd	Bkgd	Bkgd	bkgd
1	10	10	8

bkgd	bkgd	bkgd
90	60	45

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
67	2358	34823.036	21335

U-238* counts	U-234* counts	U-232sp counts
14154	11963	19508.049

U-238(dpm/g)=	6785.057	±	74.62527
U-234(dpm/g)=	5734.749	±	66.3685
Th-232(dpm/g)=	13.0157	±	1.579889
Th-230(dpm/g)=	458.0749	±	9.720727
U-234/U-238=	0.845203	±	0.010468
Th-230/U-234=	0.079877	±	0.001796
Th-230/Th-232=	35.19403	±	4.328748
U234/Th-232=	440.6024	±	53.72432

Decay constant (m-1)	U-238	Th-232
	2.948E-16	9.413E-17

U(ppb)= 9095054

Th(ppb)= 53268.35

	Spike 25A 10/9/92	Spike 25B	Spide 25C
Th-228 (dpm/g)=	3201.0332	319.75941	31.959117

U and Th Isotope Activities

FILENAME= 423UAM.CHN
423THAM.CHN

Sample # **NOPI-423-PWD(AM)**
Analyst **JDP**

Sep. date **1/10/96**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.0734	0.9652	454.83	1/22/93	1083	442.0304

Th-228/U-232= 0.7233878

Counting time for Th=	1333.33	(mins.)	Counting time for U=	2398.5	(mins.)
Days btwn. sep. and count.=	9	(days)	Days btwn. sep. and count.=	7	(days)
CF for Th-228=	0.9906565		CF for U-232=	1.0075328	

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts	U-238 counts	U-234 counts	U-232 counts
520	22652	32532	15001	14309	12188	38358

Bkgd	Bkgd	Bkgd	bkgd	bkgd	bkgd	bkgd
0	5	3	2	40	30	60

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts	U-238* counts	U-234* counts	U-232sp counts
520	22647	31513.356	14999	14269	12158	38011.664

U-238(dpm/g)=	2181.976	±	21.37404
U-234(dpm/g)=	1859.168	±	19.3316
Th-232(dpm/g)=	69.38303	±	3.066868
Th-230(dpm/g)=	3021.764	±	26.14921
U-234/U-238=	0.852057	±	0.010503
Th-230/U-234=	1.625332	±	0.018258
Th-230/Th-232=	43.55192	±	1.931675
U234/Th-232=	26.79572	±	1.216754

Decay constant (m-1)	U-238	Th-232
	2.948E-16	9.413E-17

U(ppb)= 2924838

Th(ppb)= 283958.6

	Spike 25A 10/9/92	Spike 25B	Spide 25C
Th-228 (dpm/g)=	3201.0332	319.75941	31.959117

U and Th Isotope Activities

FILENAME= 423UCR.CHN
423THCR.CHN

Sample # **NOPI-423-PWD(CR)**
Analyst **JDP**

Sep. date **1/12/96**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.4088	2.7971	454.83	1/22/93	1085	442.0071

Th-228/U-232= 0.7240755

Counting time for Th= 416.66 (mins.)
Days btwn. sep. and count.= 7 (days)
CF for Th-228= 0.9929374

Counting time for U= 2398.5 (mins.)
Days btwn. sep. and count.= 5 (days)
CF for U-232= 1.0056153

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
437	30893	23115	7445

U-238 counts	U-234 counts	U-232 counts
10676	14347	18826

Bkgd	Bkgd	Bkgd	bkgd
2	8	4	0

bkgd	bkgd	bkgd
180	210	70

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
435	30885	22442.993	7445

U-238* counts	U-234* counts	U-232sp counts
10496	14137	18651.268

		±	
U-238(dpm/g)=	1701.93	±	20.61979
U-234(dpm/g)=	2292.32	±	25.40435
Th-232(dpm/g)=	42.44423	±	2.049486
Th-230(dpm/g)=	3013.54	±	26.20771
U-234/U-238=	1.346894	±	0.017215
Th-230/U-234=	1.314625	±	0.013282
Th-230/Th-232=	71	±	3.420328
U234/Th-232=	54.00781	±	2.675655

Decay constant (m-1)	U-238	Th-232
	2.948E-16	9.413E-17

U(ppb)= 2281359

Th(ppb)= 173708.2

	Spike 25A 10/9/92	Spike 25B	Spide 25C
Th-228 (dpm/g)=	3203.9072	320.0465	31.98781

U and Th Isotope Activities

FILENAME= 423URES.CHN
423THRES.CHN

Sample # **NOPI-423-PWD(RES)**
Analyst **JDP**

Sep. date **1/10/96**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
2.0208	0.4996	454.83	1/22/93	1083	442.0304

Th-228/U-232= 0.7233878

Counting time for Th=	5737.17	(mins.)	
Days btwn. sep. and count.=	9	(days)	
CF for Th-228=	0.9891555		

Counting time for U=	2398.5	(mins.)
Days btwn. sep. and count.=	7	(days)
CF for U-232=	1.0075328	

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
213	4260	6670	6637
Bkgd	Bkgd	Bkgd	bkgd
0	0	2	10
Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
213	4260	6173.022	6627

U-238 counts	U-234 counts	U-232 counts
8616	9924	28389
bkgd	bkgd	bkgd
60	70	40
U-238* counts	U-234* counts	U-232sp counts
8556	9854	28137.048

		±	
U-238(dpm/g)=	33.231	±	0.408739
U-234(dpm/g)=	38.27236	±	0.446313
Th-232(dpm/g)=	2.727748	±	0.189863
Th-230(dpm/g)=	54.55496	±	1.069982
U-234/U-238=	1.151706	±	0.016959
Th-230/U-234=	1.42544	±	0.02611
Th-230/Th-232=	20	±	1.404219
U234/Th-232=	14.03076	±	0.990213

Decay constant (m-1)	U-238	Th-232
	2.948E-16	9.413E-17

U(ppb)= 44544.62

Th(ppb)= 11163.64

	Spike 25A	Spike 25B	Spide 25C
	10/9/92		
Th-228 (dpm/g)=	3201.0332	319.75941	31.959117

U and Th Isotope Activities

FILENAME= 425UIE.CHN
425THIE.CHN

Sample # **NOPI-425-PWD (IE)**
Analyst **JDP**

Sep. date **2/5/96**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.0211	1.8388	454.83	1/22/93	1109	441.7276

Th-228/U-232= 0.7322355

Counting time for Th=	1070.17	(mins.)	Counting time for U=	1074.24	(mins.)
Days btwn. sep. and count.=	2	(days)	Days btwn. sep. and count.=	2	(days)
CF for Th-228=	0.9976501		CF for U-232=	1.0022887	

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
3	118	32459	5569

U-238 counts	U-234 counts	U-232 counts
112	138	34244

Bkgd	Bkgd	Bkgd	bkgd
0	2	2	1

bkgd	bkgd	bkgd
1	4	7

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
3	116	32234.65	5568

U-238* counts	U-234* counts	U-232sp counts
111	134	34158.822

		±	
U-238(dpm/g)=	125.0912	±	11.83932
U-234(dpm/g)=	151.011	±	12.88078
Th-232(dpm/g)=	2.623346	±	1.51466
Th-230(dpm/g)=	101.4361	±	9.354904
U-234/U-238=	1.207207	±	0.153534
Th-230/U-234=	0.671713	±	0.084222
Th-230/Th-232=	38.66667	±	22.60621
U234/Th-232=	57.56425	±	33.597

Decay constant (m-1)	U-238	Th-232
	2.948E-16	9.413E-17

U(ppb)= 167678.9

Th(ppb)= 10736.37

	Spike 25A 10/9/92	Spike 25B	Spide 25C
Th-228 (dpm/g)=	3237.965	323.44862	32.327844

U and Th Isotope Activities

FILENAME= 425UAD.CHN
425THAD.CHN

Sample # **NOPI-425-PWD (AD)**
Analyst **JDP**

Sep. date **2/5/96**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.028	1.9914	454.83	1/22/93	1109	441.7276

Th-228/U-232= 0.7322355

Counting time for Th=	1070.9	(mins.)
Days btwn. sep. and count.=	2	(days)
CF for Th-228=	0.9976499	

Counting time for U=	1074.83	(mins.)
Days btwn. sep. and count.=	2	(days)
CF for U-232=	1.0022889	

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
5	911	40519	7223
Bkgd	Bkgd	Bkgd	bkgd
2	18	3	1

U-238 counts	U-234 counts	U-232 counts
8992	8259	42655
bkgd	bkgd	bkgd
2	6	14

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
3	893	40224.774	7222

U-238* counts	U-234* counts	U-232sp counts
8990	8253	42543.624

		±	
U-238(dpm/g)=	6638.656	±	77.03527
U-234(dpm/g)=	6094.42	±	73.26596
Th-232(dpm/g)=	1.715669	±	0.767318
Th-230(dpm/g)=	510.6974	±	17.10931
U-234/U-238=	0.91802	±	0.013992
Th-230/U-234=	0.083798	±	0.002925
Th-230/Th-232=	297.6667	±	133.4854
U234/Th-232=	3552.212	±	1589.27

Decay constant (m-1)	U-238	Th-232
	2.948E-16	9.413E-17

U(ppb)= 8898811

Th(ppb)= 7021.585

	Spike 25A 10/9/92	Spike 25B	Spide 25C
Th-228 (dpm/g)=	3237.965	323.44862	32.327844

U and Th Isotope Activities

FILENAME= 425UAM.CHN
425THAM.CHN

Sample # **NOPI-425-PWD (AM)**
Analyst **JDP**

Sep. date **2/12/96**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.0432	0.9975	4553.22	1/22/93	1116	4421.238

Th-228/U-232= 0.7345795

Counting time for Th=	1083.2	(mins.)
Days btwn. sep. and count.=	2	(days)
CF for Th-228=	0.9976457	

Counting time for U=	1083.5	(mins.)
Days btwn. sep. and count.=	2	(days)
CF for U-232=	1.0022917	

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
237	13498	193845	31409
Bkgd	Bkgd	Bkgd	bkgd
2	7	15	17

U-238 counts	U-234 counts	U-232 counts
5381	4715	185546
bkgd	bkgd	bkgd
2	4	8

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
235	13491	192384.72	31392

U-238* counts	U-234* counts	U-232sp counts
5379	4711	185113.77

U-238(dpm/g)=	2966.442	±	41.02157
U-234(dpm/g)=	2598.05	±	38.31384
Th-232(dpm/g)=	91.60288	±	5.953883
Th-230(dpm/g)=	5258.785	±	46.81318
U-234/U-238=	0.875813	±	0.017471
Th-230/U-234=	2.024128	±	0.034242
Th-230/Th-232=	57.40851	±	3.761679
U234/Th-232=	28.3621	±	1.890296

Decay constant (m-1)	U-238	Th-232
	2.948E-16	9.413E-17

U(ppb)= 3976378

Th(ppb)= 374896.1

	Spike 25A 10/9/92	Spike 25B	Spide 25C
Th-228 (dpm/g)=	3247.7508	324.42615	32.425545

U and Th Isotope Activities

FILENAME= 425UCR.CHN
425THCR.CHN

Sample # **NOPI-425-PWD (CR)**
Analyst **JDP**

Sep. date **2/5/96**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
1.2153	1.0009	4553.22	1/22/93	1109	4422.054

Th-228/U-232= 0.732231

Counting time for Th= 1333.33 (mins.)
Days btwn. sep. and count.= 5 (days)
CF for Th-228= 0.9945953

Counting time for U= 1075.9 (mins.)
Days btwn. sep. and count.= 2 (days)
CF for U-232= 1.0022892

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
161	44164	166600	46822
Bkgd	Bkgd	Bkgd	bkgd
2	9	28	20
Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
159	44155	164824.17	46802

U-238 counts	U-234 counts	U-232 counts
7107	8875	56204
bkgd	bkgd	bkgd
6	8	18
U-238* counts	U-234* counts	U-232sp counts
7101	8867	56057.672

		±	
U-238(dpm/g)=	461.3342	±	5.808025
U-234(dpm/g)=	576.0669	±	6.579994
Th-232(dpm/g)=	2.572501	±	0.202839
Th-230(dpm/g)=	714.3949	±	3.823533
U-234/U-238=	1.248697	±	0.019877
Th-230/U-234=	1.240125	±	0.014426
Th-230/Th-232=	277.7044	±	21.92603
U234/Th-232=	223.9326	±	17.84119

Decay constant (m-1)	U-238	Th-232
	2.948E-16	9.413E-17

U(ppb)= 618397.1

Th(ppb)= 10528.28

	Spike 25A 10/9/92	Spike 25B	Spide 25C
Th-228 (dpm/g)=	3237.965	323.44862	32.327844

U and Th Isotope Activities

FILENAME= 425URES.CHN
425THRES.CHN

Sample # **NOPI-425-PWD (RES)**
Analyst **JDP**

Sep. date **2/5/96**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
1.2215	1.8304	454.83	1/22/93	1109	441.7276

Th-228/U-232= 0.7322355

Counting time for Th=	1072.45	(mins.)
Days btwn. sep. and count.=	2	(days)
CF for Th-228=	0.9976493	

Counting time for U=	1076.32	(mins.)
Days btwn. sep. and count.=	2	(days)
CF for U-232=	1.0022893	

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
287	2418	41070	6930

Bkgd	Bkgd	Bkgd	bkgd
2	5	13	14

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
285	2413	40501.327	6916

U-238 counts	U-234 counts	U-232 counts
1613	1620	55428

bkgd	bkgd	bkgd
4	5	13

U-238* counts	U-234* counts	U-232sp counts
1609	1615	55288.426

		±	
U-238(dpm/g)=	19.26322	±	0.486565
U-234(dpm/g)=	19.33505	±	0.487353
Th-232(dpm/g)=	3.410621	±	0.202025
Th-230(dpm/g)=	28.87659	±	0.604283
U-234/U-238=	1.003729	±	0.035306
Th-230/U-234=	1.493484	±	0.047951
Th-230/Th-232=	8.466667	±	0.5286
U234/Th-232=	5.669071	±	0.36494

Decay constant (m-1)	U-238	Th-232
	2.948E-16	9.413E-17

U(ppb)= 25821.45

Th(ppb)= 13958.39

	Spike 25A 10/9/92	Spike 25B	Spide 25C
Th-228 (dpm/g)=	3237.965	323.44862	32.327844

U and Th Isotope Activities

FILENAME= 425UIE3.CHN
425THIE3.CHN

Sample # **NOPI-425-PWD (IE)**
Analyst **JDP**

Sep. date **5/27/96**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.0129	0.5023	454.83	1/22/93	1221	440.4255

Th-228/U-232= 0.7681737

Counting time for Th= 1666.67 (mins.)
Days btwn. sep. and count.= 54 (days)
CF for Th-228= 0.9472965

Counting time for U= 1354.3 (mins.)
Days btwn. sep. and count.= 52 (days)
CF for U-232= 1.0493026

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
25	118	14224	16314
Bkgd	Bkgd	Bkgd	bkgd
2	4	16	7

U-238 counts	U-234 counts	U-232 counts
4540	3633	5610
bkgd	bkgd	bkgd
3	7	40

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
23	114	14063.116	16307

U-238* counts	U-234* counts	U-232sp counts
4537	3626	5308.2876

U-238(dpm/g)=	14657.51	±	292.6065
U-234(dpm/g)=	11714.38	±	249.4662
Th-232(dpm/g)=	21.54526	±	4.312836
Th-230(dpm/g)=	106.7895	±	9.871466
U-234/U-238=	0.799207	±	0.017791
Th-230/U-234=	0.009116	±	0.000853
Th-230/Th-232=	4.956522	±	1.091275
U234/Th-232=	543.7104	±	109.4518

Decay constant (m-1)	U-238	Th-232
	2.948E-16	9.413E-17

U(ppb)= 19647715

Th(ppb)= 88176.61

	Spike 25A 10/9/92	Spike 25B	Spide 25C
Th-228 (dpm/g)=	3386.8718	338.3233	33.814529

U and Th Isotope Activities

FILENAME= 425UAD3.CHN
425THAD3.CHN

Sample # **NOPI-425-PWD (AD)**
Analyst **JDP**

Sep. date **6/17/96**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.0446	1.1057	4553.22	1/22/93	1242	4406.58

Th-228/U-232= 0.7745335

Counting time for Th=	833.33	(mins.)
Days btwn. sep. and count.=	33	(days)
CF for Th-228=	0.9675157	

Counting time for U=	1354.8	(mins.)
Days btwn. sep. and count.=	31	(days)
CF for U-232=	1.029895	

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
68	2905	251725	222530
Bkgd	Bkgd	Bkgd	bkgd
3	15	24	15

U-238 counts	U-234 counts	U-232 counts
3052	2596	165589
bkgd	bkgd	bkgd
2	6	8

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
65	2890	247897.61	222515

U-238* counts	U-234* counts	U-232sp counts
3050	2590	160774.64

		±	
U-238(dpm/g)=	2072.461	±	37.8582
U-234(dpm/g)=	1759.893	±	34.81062
Th-232(dpm/g)=	22.18632	±	2.69085
Th-230(dpm/g)=	986.4379	±	18.40722
U-234/U-238=	0.84918	±	0.022673
Th-230/U-234=	0.56051	±	0.015138
Th-230/Th-232=	44.46154	±	5.454493
U234/Th-232=	79.32334	±	9.747771

Decay constant (m-1)	U-238	Th-232
	2.948E-16	9.413E-17

U(ppb)= 2778038

Th(ppb)= 90800.24

	Spike 25A 10/9/92	Spike 25B	Spide 25C
Th-228 (dpm/g)=	3413.0433	340.93764	34.075825

U and Th Isotope Activities

FILENAME= 425UAM3.CHN
425THAM3.CHN

Sample # **NOPI-425-PWD (AM)**
Analyst **JDP**

Sep. date **6/17/96**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.0794	0.5008	4553.22	1/22/93	1242	4406.58

Th-228/U-232= 0.7745335

Counting time for Th=	666.67	(mins.)
Days btwn. sep. and count.=	33	(days)
CF for Th-228=	0.9675712	

Counting time for U=	1355.4	(mins.)
Days btwn. sep. and count.=	31	(days)
CF for U-232=	1.0298952	

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
82	6317	85703	77793

U-238 counts	U-234 counts	U-232 counts
4511	4005	74290

Bkgd	Bkgd	Bkgd	bkgd
1	4	4	3

bkgd	bkgd	bkgd
3	3	23

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
81	6313	84229.21	77790

U-238* counts	U-234* counts	U-232sp counts
4508	4002	72111.221

		±	
U-238(dpm/g)=	1737.507	±	26.64347
U-234(dpm/g)=	1542.48	±	25.0219
Th-232(dpm/g)=	20.70179	±	2.287224
Th-230(dpm/g)=	1613.462	±	21.03519
U-234/U-238=	0.887755	±	0.019274
Th-230/U-234=	1.046018	±	0.021128
Th-230/Th-232=	77.93827	±	8.662524
U234/Th-232=	74.50952	±	8.320395

Decay constant (m-1)	U-238	Th-232
	2.948E-16	9.413E-17

U(ppb)= 2329047

Th(ppb)= 84724.62

	Spike 25A 10/9/92	Spike 25B	Spide 25C
Th-228 (dpm/g)=	3413.0433	340.93764	34.075825

U and Th Isotope Activities

FILENAME= 425UCR3.CHN
425THCR3.CHN

Sample # **NOPI-425-PWD (CR)**
Analyst **JDP**

Sep. date **6/17/96**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
1.0616	1.0307	454.83	1/22/93	1242	440.1818

Th-228/U-232= 0.7745382

Counting time for Th= 666.67 (mins.)
Days btwn. sep. and count.= 33 (days)
CF for Th-228= 0.9675712

Counting time for U= 1355.86 (mins.)
Days btwn. sep. and count.= 31 (days)
CF for U-232= 1.0298953

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
269	34318	16703	13346
Bkgd	Bkgd	Bkgd	bkgd
5	30	7	1

U-238 counts	U-234 counts	U-232 counts
10818	13782	9457
bkgd	bkgd	bkgd
3	6	23

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
264	34288	16260.588	13345

U-238* counts	U-234* counts	U-232sp counts
10815	13776	9160.154

U-238(dpm/g)=	504.5767	±	7.103256
U-234(dpm/g)=	642.7229	±	8.582221
Th-232(dpm/g)=	5.374202	±	0.330299
Th-230(dpm/g)=	697.9949	±	6.585193
U-234/U-238=	1.273786	±	0.016362
Th-230/U-234=	1.085997	±	0.010952
Th-230/Th-232=	129.8788	±	7.949825
U234/Th-232=	119.5941	±	7.521739

Decay constant (m-1)	U-238	Th-232
	2.948E-16	9.413E-17

U(ppb)= 676361.7

Th(ppb)= 21994.58

	Spike 25A 10/9/92	Spike 25B	Spide 25C
Th-228 (dpm/g)=	3413.0433	340.93764	34.075825

U and Th Isotope Activities

FILENAME= 425RESU3.CHN
425RTH3.CHN

Sample # **NOPI-425-PWD (RES)**
Analyst **JDP**

Sep. date **6/17/96**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
1.3074	0.5026	454.83	1/22/93	1242	440.1818

Th-228/U-232= 0.7745382

Counting time for Th= 1000 (mins.)
Days btwn. sep. and count.= 36 (days)
CF for Th-228= 0.9645852

Counting time for U= 1356.4 (mins.)
Days btwn. sep. and count.= 31 (days)
CF for U-232= 1.0298955

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
250	2298	9971	10494

U-238 counts	U-234 counts	U-232 counts
2246	1809	14515

Bkgd	Bkgd	Bkgd	bkgd
2	4	15	7

bkgd	bkgd	bkgd
9	9	25

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
248	2294	9497.3177	10487

U-238* counts	U-234* counts	U-232sp counts
2237	1800	14069.388

U-238(dpm/g)=	26.90524	±	0.610061
U-234(dpm/g)=	21.64928	±	0.539795
Th-232(dpm/g)=	3.42247	±	0.219153
Th-230(dpm/g)=	31.65785	±	0.732557
U-234/U-238=	0.804649	±	0.02542
Th-230/U-234=	1.462305	±	0.045963
Th-230/Th-232=	9.25	±	0.616022
U234/Th-232=	6.325629	±	0.434676

Decay constant (m-1)	U-238	Th-232
	2.948E-16	9.413E-17

U(ppb)= 36065.22

Th(ppb)= 14006.88

	Spike 25A 10/9/92	Spike 25B	Spide 25C
Th-228 (dpm/g)=	3413.0433	340.93764	34.075825

417U1E.CHW

MCB # 1 ACQ 01-29-96 AT 11:31:28 RT : 50014.3 LT : 50000.0
No detector description was entered
NOPI-417-PWD U IE 1/30/96

ROI # 8-1 RANGE : 57 = 4.02MeV to 158 = 4.26MeV
AREA : Gross = 5685 Net = 4800 +/- 138
CENTROID : 127.82 = 4.19MeV
SHAPE : Fwhm = 0.07MeV Fwtm = 0.15MeV

ID : No close library match

ROI # 8-2 RANGE : 319 = 4.63MeV to 408 = 4.84MeV
AREA : Gross = 4129 Net = 3454 +/- 114
CENTROID : 380.05 = 4.77MeV
SHAPE : Fwhm = 0.09MeV Fwtm = 0.15MeV

ID : No close library match

ROI # 8-3 RANGE : 516 = 5.09MeV to 649 = 5.40MeV
AREA : Gross = 28315 Net = 27042 +/- 233
CENTROID : 616.96 = 5.33MeV
SHAPE : Fwhm = 0.10MeV Fwtm = 0.19MeV

ID : No close library match

417ThIE.CHN

```
MCB # 1     ACQ 01-29-96  AT 11:31:27   RT : 76284.9    LT : 76268.0
            No detector description was entered
            NOPI-417-PWD Th IE 1/30/96

ROI #  4-1  RANGE :  317 =    4.55MeV  to  382 =    4.73MeV
            AREA : Gross = 512       Net = 496          +/- 26
            CENTROID : 367.33  =    4.69MeV
            SHAPE : Fwhm =   0.03MeV    Fwtm =   0.13MeV

            ID : No close library match


ROI #  4-2  RANGE :  549 =    5.18MeV  to  667 =    5.50MeV
            AREA : Gross = 45656     Net = 44009        +/- 274
            CENTROID : 644.53  =    5.44MeV
            SHAPE : Fwhm =   0.05MeV    Fwtm =   0.16MeV

            ID : No close library match


ROI #  4-3  RANGE :  693 =    5.57MeV  to  765 =    5.77MeV
            AREA : Gross = 7892      Net = 6907         +/- 134
            CENTROID : 742.31  =    5.71MeV
            SHAPE : Fwhm =   0.07MeV    Fwtm =   0.13MeV

            ID : No close library match
```

```
MCB # 1       ACQ 01-29-96  AT 11:31:27   RT : 76284.9    LT : 76268.0
              No detector description was entered
              NOPI-417-PWD Th IE 1/30/96

ROI #  4-1    RANGE :   87 =    3.92MeV  to  126 =    4.03MeV
              AREA : Gross = 14        Net = 14          +/- 4
              Could not properly fit the peak.
```

417UAD.CHN

```
MCB # 1      ACQ 01-29-96  AT 11:31:28   RT : 76093.6    LT : 76076.7
             No detector description was entered
             NOPI-417-PWD U AD 1/30/96

ROI #  9-1   RANGE :   47 =    3.99MeV  to  164 =    4.26MeV
             AREA : Gross = 6707      Net = 6331       +/- 116
             CENTROID : 136.28  =   4.19MeV
             SHAPE : Fwhm =   0.08MeV    Fwtm =   0.18MeV

             ID : No close library match


ROI #  9-2   RANGE :  300 =    4.58MeV  to  413 =    4.84MeV
             AREA : Gross = 4745      Net = 4346       +/- 107
             CENTROID : 385.05  =   4.77MeV
             SHAPE : Fwhm =   0.11MeV    Fwtm =   0.17MeV

             ID : No close library match


ROI #  9-3   RANGE :  534 =    5.12MeV  to  649 =    5.39MeV
             AREA : Gross = 6559      Net = 6134       +/- 118
             CENTROID : 623.31  =   5.33MeV
             SHAPE : Fwhm =   0.10MeV    Fwtm =   0.19MeV

             ID : No close library match
```

417ThAD.CHN

```
MCB # 1       ACQ 01-29-96  AT 11:31:27   RT : 76325.0    LT : 76308.1
              No detector description was entered
              NOPI-417-PWD Th AD 1/30/96

ROI #  5-1    RANGE :  308 =    4.53MeV  to  386 =    4.73MeV
              AREA : Gross = 2183      Net = 2103       +/- 55
              CENTROID : 367.17  =    4.68MeV
              SHAPE : Fwhm =   0.04MeV    Fwtm =   0.12MeV

              ID : No close library match


ROI #  5-2    RANGE :  592 =    5.25MeV  to  689 =    5.50MeV
              AREA : Gross = 48601     Net = 47523      +/- 253
              CENTROID : 666.52  =    5.44MeV
              SHAPE : Fwhm =   0.04MeV    Fwtm =   0.14MeV

              ID : No close library match


ROI #  5-3    RANGE :  716 =    5.56MeV  to  793 =    5.76MeV
              AREA : Gross = 10637     Net = 10103      +/- 128
              CENTROID : 770.93  =    5.70MeV
              SHAPE : Fwhm =   0.05MeV    Fwtm =   0.11MeV

              ID : No close library match
```

```
MCB # 1        ACQ 01-29-96  AT 11:31:27   RT : 76325.0    LT : 76308.1
               No detector description was entered
               NOPI-417-PWD Th AD 1/30/96

ROI #  5-1     RANGE :    73 =    3.94MeV  to  105 =    4.02MeV
               AREA : Gross = 10       Net = 10          +/- 3
               Could not properly fit the peak.
```

417 U AM-CHW

MCB # 1 ACQ 01-29-96 AT 11:31:28 RT : 76135.0 LT : 76118.0
No detector description was entered
NOPI-417-PWD U AM 1/30/96

ROI # 10-1 RANGE : 59 = 4.05MeV to 156 = 4.28MeV
AREA : Gross = 5637 Net = 5441 +/- 92
CENTROID : 125.28 = 4.21MeV
SHAPE : Fwhm = 0.07MeV Fwtm = 0.14MeV

ID : No close library match

ROI # 10-2 RANGE : 314 = 4.65MeV to 400 = 4.85MeV
AREA : Gross = 4404 Net = 4274 +/- 78
CENTROID : 372.91 = 4.79MeV
SHAPE : Fwhm = 0.09MeV Fwtm = 0.15MeV

ID : No close library match

ROI # 10-3 RANGE : 540 = 5.18MeV to 640 = 5.42MeV
AREA : Gross = 28039 Net = 27130 +/- 204
CENTROID : 611.70 = 5.35MeV
SHAPE : Fwhm = 0.09MeV Fwtm = 0.15MeV

ID : No close library match

417ThAM.CHN

```
MCB # 1      ACQ 01-29-96  AT 11:31:27   RT : 50014.3    LT : 50000.0
             No detector description was entered
             NOPI-417-PWD Th AM 1/30/96

ROI #  6-1   RANGE :    72 =    3.94MeV  to  107 =    4.04MeV
             AREA : Gross = 115       Net = 74         +/- 17
             CENTROID : 99.87   =    4.02MeV
             SHAPE : Fwhm =   0.00MeV    Fwtm =   0.02MeV

             ID : No close library match


ROI #  6-2   RANGE :   255 =    4.44MeV  to  355 =    4.72MeV
             AREA : Gross = 46964     Net = 46510      +/- 232
             CENTROID : 337.78  =    4.67MeV
             SHAPE : Fwhm =   0.04MeV    Fwtm =   0.13MeV

             ID : No close library match


ROI #  6-3   RANGE :   537 =    5.22MeV  to  627 =    5.47MeV
             AREA : Gross = 170828    Net = 167325     +/- 466
             CENTROID : 605.16  =    5.41MeV
             SHAPE : Fwhm =   0.04MeV    Fwtm =   0.14MeV

             ID : No close library match


ROI #  6-4   RANGE :   648 =    5.53MeV  to  720 =    5.73MeV
             AREA : Gross = 27415     Net = 25652      +/- 213
             CENTROID : 697.20  =    5.66MeV
             SHAPE : Fwhm =   0.05MeV    Fwtm =   0.11MeV

             ID : No close library match
```

417UCR.CHN

```
MCB # 1        ACQ 01-29-96   AT 11:31:28    RT : 50014.3     LT : 50000.0
               No detector description was entered
               NOPI-417-PWD U CR 1/30/96

ROI # 11-1     RANGE :    61 =      4.02MeV   to   166 =      4.26MeV
               AREA : Gross = 8068       Net = 5948          +/- 203
               CENTROID : 136.91   =     4.19MeV
               SHAPE : Fwhm =    0.08MeV    Fwtm =    0.17MeV

               ID : No close library match


ROI # 11-2     RANGE :   300 =      4.57MeV   to   416 =      4.84MeV
               AREA : Gross = 10454      Net = 8154          +/- 225
               CENTROID : 388.10   =     4.77MeV
               SHAPE : Fwhm =    0.10MeV    Fwtm =    0.17MeV

               ID : No close library match


ROI # 11-3     RANGE :   545 =      5.13MeV   to   655 =      5.39MeV
               AREA : Gross = 8044       Net = 6471          +/- 184
               CENTROID : 622.87   =     5.31MeV
               SHAPE : Fwhm =    0.10MeV    Fwtm =    0.17MeV

               ID : No close library match
```

417ThCR.CHW

MCB # 2 ACQ 01-29-96 AT 11:31:43 RT : 30009.3 LT : 30000.0
No detector description was entered
NOPI-417-PWD Th CR 1/30/96

ROI # 1-1 RANGE : 438 = 4.33MeV to 682 = 4.66MeV
AREA : Gross = 195967 Net = 193802 +/- 529
Could not properly fit the peak.

ROI # 1-2 RANGE : 1047 = 5.16MeV to 1220 = 5.40MeV
AREA : Gross = 103087 Net = 99607 +/- 444
CENTROID : 1181.95 = 5.35MeV
SHAPE : Fwhm = 0.06MeV Fwtm = 0.16MeV

ID : No close library match

ROI # 1-3 RANGE : 1281 = 5.48MeV to 1405 = 5.65MeV
AREA : Gross = 8406 Net = 5468 +/- 252
CENTROID : 1374.09 = 5.61MeV
SHAPE : Fwhm = 0.06MeV Fwtm = 0.12MeV

ID : No close library match

1C 2 ACQ 01-29-96 AT 11:31:43 RT : 30009.3 LT : 30000.0
No detector description was entered
NOPI-417-PWD Th CR 1/30/96

ROI # 1-1 RANGE : 146 = 3.93MeV to 211 = 4.02MeV
AREA : Gross = 180 Net = 15 +/- 41
Could not properly fit the peak.

417URESCHN

MCB # 1 ACQ 01-29-96 AT 11:31:28 RT : 50014.3 LT : 50000.0
No detector description was entered
NOPI-417-PWD U RES 1/30/96

ROI # 12-1 RANGE : 47 = 3.98MeV to 170 = 4.27MeV
AREA : Gross = 11441 Net = 8299 +/- 265
CENTROID : 132.92 = 4.18MeV
SHAPE : Fwhm = 0.09MeV Fwtm = 0.18MeV

ID : No close library match

ROI # 12-2 RANGE : 292 = 4.55MeV to 415 = 4.84MeV
AREA : Gross = 12151 Net = 9402 +/- 252
CENTROID : 380.86 = 4.76MeV
SHAPE : Fwhm = 0.10MeV Fwtm = 0.20MeV

ID : No close library match

ROI # 12-3 RANGE : 541 = 5.13MeV to 654 = 5.39MeV
AREA : Gross = 9946 Net = 7761 +/- 217
CENTROID : 619.14 = 5.31MeV
SHAPE : Fwhm = 0.11MeV Fwtm = 0.18MeV

ID : No close library match

417Th RES.CHN

```
MCB # 2      ACQ 01-29-96  AT 11:31:43   RT : 40009.8    LT : 40000.0
             No detector description was entered
             NOPI-417-PWD Th RES 1/30/96

ROI #  2-1   RANGE :  158 =    3.94MeV  to  219 =    4.02MeV
             AREA : Gross = 126       Net = 63         +/- 26
             Could not properly fit the peak.

ROI #  2-2   RANGE :  549 =    4.46MeV  to  739 =    4.71MeV
             AREA : Gross = 54707     Net = 53117      +/- 320
             CENTROID : 705.85  =    4.67MeV
             SHAPE : Fwhm =   0.06MeV    Fwtm =   0.15MeV

             ID : No close library match

ROI #  2-3   RANGE : 1135 =    5.24MeV  to 1301 =    5.46MeV
             AREA : Gross = 25777     Net = 24662      +/- 234
             CENTROID : 1268.04 =    5.42MeV
             SHAPE : Fwhm =   0.05MeV    Fwtm =   0.15MeV

             ID : No close library match

ROI #  2-4   RANGE : 1382 =    5.57MeV  to 1502 =    5.73MeV
             AREA : Gross = 3990      Net = 3022       +/- 147
             CENTROID : 1472.98 =    5.69MeV
             SHAPE : Fwhm =   0.05MeV    Fwtm =   0.11MeV

             ID : No close library match
```

418 U1E. CHW

```
MCB # 1        ACQ 01-17-96  AT 15:46:01   RT : 143968.2   LT : 143912.6
               No detector description was entered
               NOPI-418-PWD U IE 1/19/96

ROI #   7-1    RANGE :  100 =    4.13MeV  to  157 =    4.26MeV
               AREA : Gross = 2028      Net = 1611       +/- 72
               CENTROID : 136.97  =    4.21MeV
               SHAPE : Fwhm =   0.04MeV    Fwtm =   0.11MeV

               ID : No close library match


ROI #   7-2    RANGE :  347 =    4.70MeV  to  407 =    4.84MeV
               AREA : Gross = 2160      Net = 1437       +/- 90
               CENTROID : 387.00  =    4.80MeV
               SHAPE : Fwhm =   0.03MeV    Fwtm =   0.11MeV

               ID : No close library match


ROI #   7-3    RANGE :  566 =    5.21MeV  to  647 =    5.40MeV
               AREA : Gross = 224725    Net = 215473     +/- 577
               CENTROID : 622.00  =    5.34MeV
               SHAPE : Fwhm =   0.04MeV    Fwtm =   0.12MeV

               ID : No close library match
```

418ThIE.CHN

```
MCB # 1       ACQ 01-17-96  AT 15:46:01   RT : 143968.6   LT : 143913.0
              No detector description was entered
              NOPI-418-PWD Th IE 1/19/96

ROI #  4-1    RANGE :  319 =    4.55MeV  to  382 =    4.73MeV
              AREA : Gross = 1296      Net = 1008       +/- 62
              CENTROID : 366.88  =    4.68MeV
              SHAPE : Fwhm =   0.04MeV    Fwtm =   0.12MeV

              ID : No close library match


ROI #  4-2    RANGE :  506 =    5.06MeV  to  670 =    5.51MeV
              AREA : Gross = 197492    Net = 193503     +/- 547
              CENTROID : 645.38  =    5.44MeV
              SHAPE : Fwhm =   0.05MeV    Fwtm =   0.16MeV

              ID : No close library match


ROI #  4-3    RANGE :  690 =    5.56MeV  to  766 =    5.77MeV
              AREA : Gross = 53469     Net = 49157      +/- 317
              CENTROID : 743.18  =    5.71MeV
              SHAPE : Fwhm =   0.06MeV    Fwtm =   0.13MeV

              ID : No close library match
```

```
MCB # 1        ACQ 01-17-96  AT 15:46:01   RT : 143968.6   LT : 143913.0
               No detector description was entered
               NOPI-418-PWD Th IE 1/19/96

ROI #   4-1    RANGE :    86 =     3.92MeV  to  124 =     4.02MeV
               AREA : Gross = 43          Net = 13           +/- 13
               CENTROID : 90.17    =    3.93MeV
               SHAPE : Fwhm =   0.00MeV    Fwtm =   0.01MeV

               ID : No close library match
```

418uAD2-CHW

```
MCB # 1        ACQ 01-29-96  AT 11:31:28   RT : 60015.4    LT : 60000.0
               No detector description was entered
               NOPI-418-PWD U AD 1/30/96

ROI #  7-1     RANGE :   68 =    4.05MeV  to  161 =    4.27MeV
               AREA : Gross = 3109      Net = 2968       +/- 71
               CENTROID : 130.94  =    4.20MeV
               SHAPE : Fwhm =   0.08MeV    Fwtm =   0.16MeV

               ID : No close library match


ROI #  7-2     RANGE :  318 =    4.64MeV  to  408 =    4.84MeV
               AREA : Gross = 2424      Net = 2288       +/- 65
               CENTROID : 383.54  =    4.79MeV
               SHAPE : Fwhm =   0.08MeV    Fwtm =   0.14MeV

               ID : No close library match


ROI #  7-3     RANGE :  562 =    5.20MeV  to  645 =    5.40MeV
               AREA : Gross = 2255      Net = 1974       +/- 75
               CENTROID : 620.13  =    5.34MeV
               SHAPE : Fwhm =   0.07MeV    Fwtm =   0.14MeV

               ID : No close library match
```

418ThAD2.CHW

```
MCB # 1      ACQ 01-29-96   AT 11:31:27    RT : 76245.6     LT : 76228.7
             No detector description was entered
             NOPI-418-PWD Th AD 1/30/96

ROI #  2-1   RANGE :  299 =     4.56MeV  to  368 =     4.74MeV
             AREA : Gross = 3229       Net = 3019       +/- 73
             CENTROID : 348.12  =    4.69MeV
             SHAPE : Fwhm =   0.04MeV    Fwtm =   0.11MeV

             ID : No close library match


ROI #  2-2   RANGE :  571 =     5.25MeV  to  674 =     5.52MeV
             AREA : Gross = 78456      Net = 77606      +/- 302
             CENTROID : 645.08  =    5.44MeV
             SHAPE : Fwhm =   0.03MeV    Fwtm =   0.07MeV

             ID : No close library match


ROI #  2-3   RANGE :  698 =     5.58MeV  to  772 =     5.77MeV
             AREA : Gross = 14483      Net = 13958      +/- 141
             CENTROID : 748.28  =    5.71MeV
             SHAPE : Fwhm =   0.05MeV    Fwtm =   0.10MeV

             ID : No close library match
```

ICB # 1 ACQ 01-29-96 AT 11:31:27 RT : 76245.6 LT : 76228.7
No detector description was entered
NOPI-418-PWD Th AD 1/30/96

ROI # 2-1 RANGE : 48 = 3.92MeV to 87 = 4.02MeV
AREA : Gross = 19 Net = 19 +/- 4
Could not properly fit the peak.

418UAM2.CHW

MCB # 1 ACQ 02-07-96 AT 15:12:57 RT : 64422.2 LT : 64405.0
No detector description was entered
NOPI-418-PWD U AM 2/8/96

ROI # 7-1 RANGE : 58 = 4.03MeV to 160 = 4.27MeV
AREA : Gross = 6914 Net = 6074 +/- 140
CENTROID : 127.13 = 4.19MeV
SHAPE : Fwhm = 0.10MeV Fwtm = 0.19MeV

ID : No close library match

ROI # 7-2 RANGE : 302 = 4.60MeV to 406 = 4.84MeV
AREA : Gross = 5949 Net = 5388 +/- 121
CENTROID : 377.64 = 4.77MeV
SHAPE : Fwhm = 0.11MeV Fwtm = 0.19MeV

ID : No close library match

ROI # 7-3 RANGE : 550 = 5.18MeV to 642 = 5.39MeV
AREA : Gross = 9445 Net = 8383 +/- 154
CENTROID : 612.17 = 5.32MeV
SHAPE : Fwhm = 0.11MeV Fwtm = 0.17MeV

ID : No close library match

418ThAM2.CHN

```
MCB # 1       ACQ 02-07-96  AT 15:12:57   RT : 30009.3    LT : 30000.0
              No detector description was entered
              NOPI-418-PWD Th AM 2/8/96

ROI #  4-1    RANGE :   89 =    3.93MeV  to  124 =    4.02MeV
              AREA : Gross = 158       Net = 32          +/- 26
              Could not properly fit the peak.

ROI #  4-2    RANGE :  253 =    4.37MeV  to  386 =    4.74MeV
              AREA : Gross = 50223     Net = 49578       +/- 252
              CENTROID : 362.90  =    4.67MeV
              SHAPE : Fwhm =   0.09MeV    Fwtm =   0.15MeV

              ID : No close library match

ROI #  4-3    RANGE :  569 =    5.24MeV  to  665 =    5.50MeV
              AREA : Gross = 47038     Net = 45275       +/- 268
              CENTROID : 642.16  =    5.43MeV
              SHAPE : Fwhm =   0.05MeV    Fwtm =   0.16MeV

              ID : No close library match

ROI #  4-4    RANGE :  687 =    5.56MeV  to  761 =    5.76MeV
              AREA : Gross = 6913      Net = 6028        +/- 127
              CENTROID : 737.73  =    5.69MeV
              SHAPE : Fwhm =   0.07MeV    Fwtm =   0.14MeV

              ID : No close library match
```

418 UCR2.CHN

ICB # 1	ACQ 02-14-96	AT 14:00:26	RT : 64988.2	LT : 64978.7		

No detector description was entered
NOPI-418-PWD U CR 2/15/96

ROI # 7-1
RANGE : 68 = 4.05MeV to 160 = 4.27MeV
AREA : Gross = 8030 Net = 5767 +/- 196
CENTROID : 130.90 = 4.20MeV
SHAPE : Fwhm = 0.08MeV Fwtm = 0.14MeV

ID : No close library match

ROI # 7-2
RANGE : 316 = 4.63MeV to 408 = 4.84MeV
AREA : Gross = 10759 Net = 8650 +/- 198
CENTROID : 380.69 = 4.78MeV
SHAPE : Fwhm = 0.08MeV Fwtm = 0.15MeV

ID : No close library match

ROI # 7-3
RANGE : 567 = 5.21MeV to 646 = 5.40MeV
AREA : Gross = 8658 Net = 7125 +/- 161
CENTROID : 617.48 = 5.33MeV
SHAPE : Fwhm = 0.08MeV Fwtm = 0.13MeV

ID : No close library match

418 ThCR2.CHN

```
ICB # 2     ACQ 02-14-96   AT 13:59:22   RT : 50021.8    LT : 50000.0
            No detector description was entered
            NOPI-418-PWD Th CR 2/15/96

ROI #  1-1  RANGE :  150 =    3.93MeV  to  226 =    4.04MeV
            AREA : Gross = 1121       Net = 209        +/- 105
            CENTROID : 203.11  =    4.01MeV
            SHAPE : Fwhm =   0.00MeV    Fwtm =   0.00MeV

            ID : No close library match


ROI #  1-2  RANGE :  479 =    4.39MeV  to  722 =    4.72MeV
            AREA : Gross = 365141    Net = 352412     +/- 926
            Could not properly fit the peak.

ROI #  1-3  RANGE : 1011 =    5.11MeV  to 1279 =    5.48MeV
            AREA : Gross = 212816    Net = 203132     +/- 792
            Could not properly fit the peak.

ROI #  1-4  RANGE : 1328 =    5.55MeV  to 1484 =    5.76MeV
            AREA : Gross = 34944     Net = 25632      +/- 510
            CENTROID : 1435.20 =    5.70MeV
            SHAPE : Fwhm =   0.09MeV    Fwtm =   0.15MeV

            ID : No close library match
```

418URES.CHN

```
MCB # 1      ACQ 01-17-96  AT 15:46:02   RT : 143967.6   LT : 143912.1
             No detector description was entered
             NOPI-418-PWD U RES 1/19/96

ROI # 11-1   RANGE :   71 =    4.04MeV  to  166 =    4.26MeV
             AREA : Gross = 21107     Net = 20003      +/- 191
             CENTROID : 138.75  =    4.20MeV
             SHAPE : Fwhm =   0.08MeV    Fwtm =   0.15MeV

             ID : No close library match


ROI # 11-2   RANGE :  303 =    4.58MeV  to  418 =    4.84MeV
             AREA : Gross = 24710     Net = 23666      +/- 207
             CENTROID : 387.63  =    4.77MeV
             SHAPE : Fwhm =   0.09MeV    Fwtm =   0.15MeV

             ID : No close library match


ROI # 11-3   RANGE :  570 =    5.19MeV  to  655 =    5.39MeV
             AREA : Gross = 90392     Net = 82308      +/- 436
             CENTROID : 626.58  =    5.32MeV
             SHAPE : Fwhm =   0.09MeV    Fwtm =   0.15MeV

             ID : No close library match
```

418 Th Res.CHW

```
ICB # 2       ACQ 01-19-96  AT 09:27:38   RT : 20015.1    LT : 20000.0
              No detector description was entered
              NOPI-418-PWD Th RES 1/19/96

ROI #   2-1   RANGE :  347 =     4.19MeV  to  743 =     4.72MeV
              AREA : Gross = 328483    Net = 326230     +/- 688
              Could not properly fit the peak.

ROI #   2-2   RANGE :  996 =     5.05MeV  to 1314 =     5.48MeV
              AREA : Gross = 188032    Net = 179897     +/- 777
              Could not properly fit the peak.

ROI #   2-3   RANGE : 1341 =     5.51MeV  to 1513 =     5.74MeV
              AREA : Gross = 65215     Net = 56997      +/- 535
              CENTROID : 1467.84 =     5.68MeV
              SHAPE : Fwhm =   0.06MeV    Fwtm =   0.13MeV

              ID : No close library match
```

```
MC[illegible] # 2    ACQ 01-19-96  AT 09:27:38   RT : 20015.1    LT : 20000.0
          No detector description was entered
          NOPI-418-PWD Th RES 1/19/96

ROI #  2-1    RANGE :  146 =     3.92MeV  to  218 =     4.02MeV
          AREA : Gross = 330        Net = 110          +/- 51
          Could not properly fit the peak.
```

418IEU3.CHN

ICB # 1	ACQ 07-16-96 AT 07:56:19 RT : 87942.2 LT : 87925.0 No detector description was entered NOPI-418-PWD IE U 7/17/96
ROI # 10-1	RANGE : 77 = 4.09MeV to 145 = 4.25MeV AREA : Gross = 1508 Net = 1360 +/- 54 CENTROID : 124.23 = 4.21MeV SHAPE : Fwhm = 0.06MeV Fwtm = 0.12MeV ID : No close library match
ROI # 10-2	RANGE : 324 = 4.68MeV to 394 = 4.84MeV AREA : Gross = 1434 Net = 1303 +/- 52 CENTROID : 372.78 = 4.79MeV SHAPE : Fwhm = 0.08MeV Fwtm = 0.13MeV ID : No close library match
ROI 10-3	RANGE : 545 = 5.20MeV to 633 = 5.40MeV AREA : Gross = 34885 Net = 33342 +/- 234 CENTROID : 611.69 = 5.35MeV SHAPE : Fwhm = 0.09MeV Fwtm = 0.14MeV ID : No close library match

418IETh3.CHN

```
MCB # 1      ACQ 07-16-96  AT 07:56:19   RT : 87696.3    LT : 87679.1
             No detector description was entered
             NOPI-418-PWD IE TH 7/17/96

ROI #  6-1   RANGE :   65 =    3.92MeV  to  106 =    4.03MeV
             AREA : Gross = 24        Net = 14          +/- 9
             Could not properly fit the peak.

ROI #  6-2   RANGE :  270 =    4.49MeV  to  350 =    4.71MeV
             AREA : Gross = 1025      Net = 916         +/- 48
             CENTROID : 336.54  =    4.67MeV
             SHAPE : Fwhm =   0.02MeV    Fwtm =   0.13MeV

             ID : No close library match

ROI    6-3   RANGE :  523 =    5.18MeV  to  617 =    5.44MeV
             AREA : Gross = 28495     Net = 23096       +/- 321
             CENTROID : 600.15  =    5.40MeV
             SHAPE : Fwhm =   0.06MeV    Fwtm =   0.15MeV

             ID : No close library match

ROI #  6-4   RANGE :  632 =    5.48MeV  to  713 =    5.71MeV
             AREA : Gross = 21245     Net = 15833       +/- 290
             CENTROID : 691.01  =    5.65MeV
             SHAPE : Fwhm =   0.11MeV    Fwtm =   0.19MeV

             ID : No close library match
```

418ADU3.CHN

```
ICB # 1       ACQ 07-16-96  AT 07:56:19   RT : 87988.1     LT : 87971.0
              No detector description was entered
              NOPI-418-PWD AD U 7/17/96

ROI # 11-1    RANGE :    82 =     4.07MeV  to  161 =     4.25MeV
              AREA : Gross = 4835       Net = 4715         +/- 79
              CENTROID : 137.55  =    4.20MeV
              SHAPE : Fwhm =   0.07MeV    Fwtm =   0.13MeV

              ID : No close library match


ROI # 11-2    RANGE :   331 =     4.64MeV  to  411 =     4.83MeV
              AREA : Gross = 3696       Net = 3534         +/- 75
              CENTROID : 387.54  =    4.77MeV
              SHAPE : Fwhm =   0.05MeV    Fwtm =   0.12MeV

              ID : No close library match


ROI # 11-3    RANGE :   566 =     5.18MeV  to  652 =     5.38MeV
              AREA : Gross = 7596       Net = 7218         +/- 111
              CENTROID : 626.54  =    5.32MeV
              SHAPE : Fwhm =   0.06MeV    Fwtm =   0.14MeV

              ID : No close library match
```

418ADTh3CHW

```
MCB # 1      ACQ 07-17-96  AT 08:53:12   RT : 30031.7    LT : 30000.0
             No detector description was entered
             NOPI-418-PWD AD Th 7/18/96

ROI #  2-1   RANGE :   55 =    3.94MeV  to   87 =    4.02MeV
             AREA : Gross = 36        Net = 5          +/- 12
             Could not properly fit the peak.

ROI #  2-2   RANGE :  257 =    4.45MeV  to  362 =    4.72MeV
             AREA : Gross = 14674     Net = 14477      +/- 133
             CENTROID : 342.58  =    4.67MeV
             SHAPE : Fwhm =   0.05MeV    Fwtm =   0.14MeV

             ID : No close library match

ROI #  2-3   RANGE :  563 =    5.23MeV  to  663 =    5.49MeV
             AREA : Gross = 58659     Net = 55749      +/- 319
             CENTROID : 638.79  =    5.43MeV
             SHAPE : Fwhm =   0.05MeV    Fwtm =   0.15MeV

             ID : No close library match

ROI #  2-4   RANGE :  683 =    5.54MeV  to  767 =    5.75MeV
             AREA : Gross = 53384     Net = 49474      +/- 318
             CENTROID : 741.40  =    5.69MeV
             SHAPE : Fwhm =   0.06MeV    Fwtm =   0.14MeV

             ID : No close library match
```

418AMU3.CHW

```
MCB # 1     ACQ 07-16-96  AT 07:56:20   RT : 88028.1    LT : 88010.9
            No detector description was entered
            NOPI-418-PWD AM U 7/17/96

ROI # 12-1  RANGE :  100 =    4.11MeV  to  151 =    4.23MeV
            AREA : Gross = 167       Net = 114        +/- 23
            CENTROID : 135.08  =    4.19MeV
            SHAPE : Fwhm =   0.00MeV    Fwtm =   0.06MeV

            ID : No close library match

ROI # 12-2  RANGE :  367 =    4.73MeV  to  401 =    4.81MeV
            AREA : Gross = 92        Net = 39         +/- 17
            CENTROID : 391.89  =    4.78MeV
            SHAPE : Fwhm =   0.00MeV    Fwtm =   0.03MeV

            ID : No close library match

ROI # 12-3  RANGE :  551 =    5.15MeV  to  648 =    5.38MeV
            AREA : Gross = 14870     Net = 14184      +/- 157
            CENTROID : 629.35  =    5.33MeV
            SHAPE : Fwhm =   0.09MeV    Fwtm =   0.15MeV

            ID : No close library match
```

418AmTh3.CHN

ICB # 1	ACQ 07-17-96	AT 08:53:12	RT : 30031.7	LT : 30000.0		

No detector description was entered
NOPI-418-PWD AM Th 7/18/96

ROI # 4-1
RANGE : 90 = 3.93MeV to 122 = 4.02MeV
AREA : Gross = 87 Net = 22 +/- 18
CENTROID : 112.09 = 3.99MeV
SHAPE : Fwhm = 0.00MeV Fwtm = 0.01MeV

ID : No close library match

ROI # 4-2
RANGE : 283 = 4.46MeV to 383 = 4.73MeV
AREA : Gross = 54837 Net = 53808 +/- 265
CENTROID : 363.09 = 4.67MeV
SHAPE : Fwhm = 0.06MeV Fwtm = 0.15MeV

ID : No close library match

ROI # 4-3
RANGE : 570 = 5.24MeV to 664 = 5.49MeV
AREA : Gross = 65071 Net = 61571 +/- 337
CENTROID : 641.74 = 5.43MeV
SHAPE : Fwhm = 0.05MeV Fwtm = 0.15MeV

ID : No close library match

ROI # 4-4
RANGE : 683 = 5.55MeV to 760 = 5.76MeV
AREA : Gross = 57719 Net = 53248 +/- 327
CENTROID : 737.09 = 5.69MeV
SHAPE : Fwhm = 0.07MeV Fwtm = 0.14MeV

ID : No close library match

418CRU3.CHW

```
MCB # 1       ACQ 07-16-96  AT 07:56:20   RT : 40013.5    LT : 40000.0
              No detector description was entered
              NOPI-418-PWD CR U 7/17/96

ROI # 13-1    RANGE :   59 =     4.04MeV  to  152 =     4.26MeV
              AREA : Gross = 7291       Net = 6178       +/- 150
              CENTROID : 120.43  =     4.19MeV
              SHAPE : Fwhm =   0.10MeV    Fwtm =   0.16MeV

              ID : No close library match


ROI # 13-2    RANGE :  294 =     4.59MeV  to  402 =     4.84MeV
              AREA : Gross = 11303      Net = 10041      +/- 178
              CENTROID : 367.87  =     4.76MeV
              SHAPE : Fwhm =   0.10MeV    Fwtm =   0.18MeV

              ID : No close library match


ROI # 13-3    RANGE :  554 =     5.19MeV  to  635 =     5.38MeV
              AREA : Gross = 3525       Net = 2852       +/- 107
              CENTROID : 607.81  =     5.32MeV
              SHAPE : Fwhm =   0.09MeV    Fwtm =   0.14MeV

              ID : No close library match
```

418 CRTh3.CHN

```
MCB # 1       ACQ 07-17-96  AT 08:53:12   RT : 30031.7    LT : 30000.0
              No detector description was entered
              NOPI-418-PWD CR Th 7/18/96

ROI #  5-1    RANGE :   75 =    3.94MeV  to  108 =    4.03MeV
              AREA : Gross = 473        Net = 135        +/- 41
              Could not properly fit the peak.

ROI #  5-2    RANGE :  257 =    4.40MeV  to  387 =    4.73MeV
              AREA : Gross = 505517    Net = 501501     +/- 765
              CENTROID : 364.91  =    4.68MeV
              SHAPE : Fwhm =   0.05MeV    Fwtm =   0.14MeV

              ID : No close library match

ROI #  5-3    RANGE :  593 =    5.25MeV  to  693 =    5.51MeV
              AREA : Gross = 105458    Net = 99146      +/- 446
              CENTROID : 666.73  =    5.44MeV
              SHAPE : Fwhm =   0.05MeV    Fwtm =   0.15MeV

              ID : No close library match

ROI #  5-4    RANGE :  715 =    5.56MeV  to  800 =    5.78MeV
              AREA : Gross = 100739    Net = 88815      +/- 498
              CENTROID : 771.57  =    5.70MeV
              SHAPE : Fwhm =   0.07MeV    Fwtm =   0.13MeV

              ID : No close library match
```

418CRU3a.CHN

```
MCB # 1        ACQ 07-16-96  AT 07:56:20   RT : 50014.6    LT : 50000.0
               No detector description was entered
               NOPI-418-PWD CR U 7/17/96

ROI # 15-1     RANGE :   71 =    4.07MeV  to  152 =    4.26MeV
               AREA : Gross = 5065      Net = 4819       +/- 89
               CENTROID : 124.20  =    4.19MeV
               SHAPE : Fwhm =   0.08MeV    Fwtm =   0.14MeV

               ID : No close library match


ROI # 15-2     RANGE :  311 =    4.63MeV  to  402 =    4.84MeV
               AREA : Gross = 7993      Net = 7625       +/- 114
               CENTROID : 374.41  =    4.78MeV
               SHAPE : Fwhm =   0.09MeV    Fwtm =   0.15MeV

               ID : No close library match


ROI # 15-3     RANGE :  566 =    5.22MeV  to  637 =    5.39MeV
               AREA : Gross = 2532      Net = 2301       +/- 70
               CENTROID : 615.02  =    5.34MeV
               SHAPE : Fwhm =   0.05MeV    Fwtm =   0.13MeV

               ID : No close library match
```

418RESU3.CHN

CB # 1	ACQ 07-16-96	AT 07:56:20	RT : 88110.2		LT : 88093.0			

No detector description was entered
NOPI-418-PWD RES U 7/17/96

OI # 14-1
RANGE : 81 = 4.07MeV to 151 = 4.24MeV
AREA : Gross = 1070 Net = 917 +/- 51
CENTROID : 123.02 = 4.17MeV
SHAPE : Fwhm = 0.08MeV Fwtm = 0.12MeV

ID : No close library match

OI # 14-2
RANGE : 323 = 4.64MeV to 401 = 4.82MeV
AREA : Gross = 1329 Net = 1077 +/- 64
CENTROID : 380.97 = 4.77MeV
SHAPE : Fwhm = 0.02MeV Fwtm = 0.13MeV

ID : No close library match

OI 14-3
RANGE : 549 = 5.17MeV to 642 = 5.38MeV
AREA : Gross = 29776 Net = 27865 +/- 236
CENTROID : 615.99 = 5.32MeV
SHAPE : Fwhm = 0.09MeV Fwtm = 0.15MeV

ID : No close library match

418 RTH3.CHN

```
MCB # 1      ACQ 07-17-96  AT 08:52:57   RT : 60035.6    LT : 60000.0
             No detector description was entered
             NOPI-418-PWD RES Th 7/18/96

ROI #  6-1   RANGE :   77 =    3.95MeV  to  104 =    4.03MeV
             AREA : Gross = 13        Net = -13        +/- 9
             Could not properly fit the peak.

ROI #  6-2   RANGE :  271 =    4.49MeV  to  351 =    4.71MeV
             AREA : Gross = 1465      Net = 1303       +/- 58
             CENTROID : 332.90  =    4.66MeV
             SHAPE : Fwhm =   0.05MeV    Fwtm =   0.15MeV

             ID : No close library match


ROI #  6-3   RANGE :  512 =    5.15MeV  to  616 =    5.44MeV
             AREA : Gross = 25414     Net = 19289      +/- 347
             CENTROID : 598.55  =    5.39MeV
             SHAPE : Fwhm =   0.06MeV    Fwtm =   0.19MeV

             ID : No close library match


ROI #  6-4   RANGE :  635 =    5.49MeV  to  714 =    5.71MeV
             AREA : Gross = 17134     Net = 11987      +/- 275
             CENTROID : 689.24  =    5.64MeV
             SHAPE : Fwhm =   0.11MeV    Fwtm =   0.18MeV

             ID : No close library match
```

420 U IE.CHN

```
MCB # 1       ACQ 02-09-96  AT 11:40:51   RT : 125027.9   LT : 125000.0
              No detector description was entered
              NOPI-420-PWD U IE 2/12/96

ROI #  8-1    RANGE :  106 =    4.14MeV  to  152 =    4.24MeV
              AREA : Gross = 431       Net = 196        +/- 42
              CENTROID : 140.96  =    4.22MeV
              SHAPE : Fwhm =   0.00MeV    Fwtm =   0.04MeV

              ID : No close library match


ROI #  8-2    RANGE :  325 =    4.65MeV  to  384 =    4.78MeV
              AREA : Gross = 639       Net = 149        +/- 68
              Could not properly fit the peak.

ROI #  8-3    RANGE :  560 =    5.19MeV  to  648 =    5.40MeV
              AREA : Gross = 74928     Net = 71398      +/- 347
              CENTROID : 624.02  =    5.34MeV
              SHAPE : Fwhm =   0.05MeV    Fwtm =   0.13MeV

              ID : No close library match
```

420ThIE.CHN

```
ICB # 1       ACQ 02-09-96  AT 11:40:51   RT : 130028.0   LT : 130000.0
              No detector description was entered
              NOPI-420-PWD Th IE 2/12/96

ROI #  4-1    RANGE :   86 =    3.92MeV  to  122 =    4.02MeV
              AREA : Gross = 19         Net = 19         +/- 4
              Could not properly fit the peak.


ROI #  4-2    RANGE :  320 =    4.56MeV  to  383 =    4.73MeV
              AREA : Gross = 234        Net = 171        +/- 28
              CENTROID : 355.08  =    4.65MeV
              SHAPE : Fwhm =   0.00MeV    Fwtm =   0.08MeV

              ID : No close library match


ROI #  4-3    RANGE :  510 =    5.07MeV  to  666 =    5.50MeV
              AREA : Gross = 61728      Net = 58456      +/- 375
              CENTROID : 643.14  =    5.44MeV
              SHAPE : Fwhm =   0.06MeV    Fwtm =   0.18MeV

              ID : No close library match


ROI #  4-4    RANGE :  691 =    5.57MeV  to  766 =    5.77MeV
              AREA : Gross = 14829      Net = 11751      +/- 218
              CENTROID : 742.05  =    5.71MeV
              SHAPE : Fwhm =   0.07MeV    Fwtm =   0.15MeV

              ID : No close library match
```

420 UAD.CHN

```
MCB # 1        ACQ 02-09-96  AT 11:40:51   RT : 75021.0    LT : 75000.0
               No detector description was entered
               NOPI-420-PWD U AD 2/12/96

ROI #  9-1     RANGE :   70 =    4.04MeV  to  163 =    4.26MeV
               AREA : Gross = 14312     Net = 13748      +/- 148
               CENTROID : 135.21  =    4.19MeV
               SHAPE : Fwhm =   0.09MeV    Fwtm =   0.15MeV

               ID : No close library match


ROI #  9-2     RANGE :  320 =    4.62MeV  to  410 =    4.83MeV
               AREA : Gross = 12488     Net = 12016      +/- 137
               CENTROID : 382.55  =    4.77MeV
               SHAPE : Fwhm =   0.09MeV    Fwtm =   0.15MeV

               ID : No close library match


ROI #  9-3     RANGE :  549 =    5.16MeV  to  649 =    5.39MeV
               AREA : Gross = 55760     Net = 54548      +/- 272
               CENTROID : 622.44  =    5.33MeV
               SHAPE : Fwhm =   0.10MeV    Fwtm =   0.16MeV

               ID : No close library match
```

420 Th AD.CHN

```
MCB # 1      ACQ 02-09-96  AT 11:40:51   RT : 120027.6   LT : 120000.0
             No detector description was entered
             NOPI-420-PWD Th AD 2/12/96

ROI #  5-1   RANGE :   74 =    3.94MeV  to  104 =    4.02MeV
             AREA : Gross = 35        Net = 4           +/- 12
             Could not properly fit the peak.

ROI #  5-2   RANGE :  278 =    4.46MeV  to  383 =    4.72MeV
             AREA : Gross = 1212      Net = 1000        +/- 67
             CENTROID : 334.48  =    4.60MeV
             SHAPE : Fwhm =   0.08MeV    Fwtm =   0.16MeV

             ID : No close library match

ROI #  5-3   RANGE :  541 =    5.12MeV  to  684 =    5.48MeV
             AREA : Gross = 93152     Net = 83504       +/- 553
             CENTROID : 640.94  =    5.37MeV
             SHAPE : Fwhm =   0.14MeV    Fwtm =   0.25MeV

             ID : No close library match

ROI #  5-4   RANGE :  700 =    5.52MeV  to  797 =    5.77MeV
             AREA : Gross = 20630     Net = 14145       +/- 337
             CENTROID : 751.63  =    5.65MeV
             SHAPE : Fwhm =   0.10MeV    Fwtm =   0.20MeV

             ID : No close library match
```

420 u AM.CHN

```
MCB # 1      ACQ 02-09-96  AT 11:40:52   RT : 80021.8    LT : 80000.0
             No detector description was entered
             NOPI-420-PWD U AM 2/12/96

ROI # 10-1   RANGE :    53 =    4.04MeV  to  152 =    4.27MeV
             AREA : Gross = 12160     Net = 11410      +/- 152
             CENTROID : 122.36  =    4.20MeV
             SHAPE : Fwhm =   0.08MeV    Fwtm =   0.15MeV

             ID : No close library match


ROI # 10-2   RANGE :   296 =    4.61MeV  to  401 =    4.86MeV
             AREA : Gross = 11958     Net = 11144      +/- 157
             CENTROID : 370.22  =    4.78MeV
             SHAPE : Fwhm =   0.09MeV    Fwtm =   0.16MeV

             ID : No close library match


ROI # 10-3   RANGE :   529 =    5.16MeV  to  638 =    5.42MeV
             AREA : Gross = 221628    Net = 216623     +/- 551
             CENTROID : 606.69  =    5.34MeV
             SHAPE : Fwhm =   0.10MeV    Fwtm =   0.17MeV

             ID : No close library match
```

420 Th Am c Hw

```
MCB # 1      ACQ 02-09-96  AT 11:40:51   RT : 70020.2    LT : 70000.0
             No detector description was entered
             NOPI-420-PWD Th AM 2/12/96

ROI #  6-1   RANGE :   64 =    3.92MeV  to  103 =    4.03MeV
             AREA : Gross = 255       Net = 61          +/- 34
             Could not properly fit the peak.

ROI #  6-2   RANGE :  240 =    4.40MeV  to  356 =    4.72MeV
             AREA : Gross = 24596     Net = 23660       +/- 202
             CENTROID : 332.48  =    4.66MeV
             SHAPE : Fwhm =   0.10MeV    Fwtm =   0.17MeV

             ID : No close library match

ROI #  6-3   RANGE :  511 =    5.15MeV  to  622 =    5.46MeV
             AREA : Gross = 245688    Net = 228123      +/- 734
             CENTROID : 601.23  =    5.40MeV
             SHAPE : Fwhm =   0.06MeV    Fwtm =   0.17MeV

             ID : No close library match

ROI #  6-4   RANGE :  645 =    5.52MeV  to  717 =    5.72MeV
             AREA : Gross = 49051     Net = 36155       +/- 424
             CENTROID : 693.29  =    5.65MeV
             SHAPE : Fwhm =   0.08MeV    Fwtm =   0.15MeV

             ID : No close library match
```

420UCR.CHN

```
MCB # 1      ACQ 02-09-96  AT 11:40:52   RT : 80021.8    LT : 80000.0
             No detector description was entered
             NOPI-420-PWD U CR 2/12/96

ROI # 11-1   RANGE :    79 =    4.06MeV  to  166 =    4.26MeV
             AREA : Gross = 8866      Net = 8250       +/- 129
             CENTROID : 137.06  =    4.19MeV
             SHAPE : Fwhm =   0.08MeV    Fwtm =   0.15MeV

             ID : No close library match


ROI # 11-2   RANGE :   318 =    4.61MeV  to  417 =    4.84MeV
             AREA : Gross = 11014     Net = 10481      +/- 137
             CENTROID : 385.75  =    4.77MeV
             SHAPE : Fwhm =   0.09MeV    Fwtm =   0.15MeV

             ID : No close library match


ROI # 11-3   RANGE :   556 =    5.16MeV  to  655 =    5.39MeV
             AREA : Gross = 34116     Net = 32733      +/- 233
             CENTROID : 623.62  =    5.31MeV
             SHAPE : Fwhm =   0.10MeV    Fwtm =   0.15MeV

             ID : No close library match
```

420 Th CR.CHW

```
MCB # 2      ACQ 02-09-96  AT 11:41:03   RT : 50009.8    LT : 50000.0
             No detector description was entered
             NOPI-420-PWD Th CR 2/12/96

ROI #  1-1   RANGE :  141 =    3.92MeV  to  209 =    4.02MeV
             AREA : Gross = 338       Net = 200        +/- 41
             Could not properly fit the peak.

ROI #  1-2   RANGE :  528 =    4.45MeV  to  721 =    4.72MeV
             AREA : Gross = 82853     Net = 78197      +/- 473
             CENTROID : 688.09  =    4.67MeV
             SHAPE : Fwhm =   0.11MeV    Fwtm =   0.18MeV

             ID : No close library match

ROI #  1-3   RANGE : 1065 =    5.19MeV  to 1274 =    5.47MeV
             AREA : Gross = 171304    Net = 156709     +/- 808
             CENTROID : 1239.41 =    5.43MeV
             SHAPE : Fwhm =   0.06MeV    Fwtm =   0.18MeV

             ID : No close library match

ROI #  1-4   RANGE : 1323 =    5.54MeV  to 1477 =    5.75MeV
             AREA : Gross = 28527     Net = 17860      +/- 532
             CENTROID : 1425.51 =    5.68MeV
             SHAPE : Fwhm =   0.10MeV    Fwtm =   0.16MeV

             ID : No close library match
```

420 U RES.CHN

```
ICB # 1      ACQ 02-09-96  AT 11:40:52   RT : 80021.8    LT : 80000.0
             No detector description was entered
             NOPI-420-PWD U RES 2/12/96

ROI # 12-1   RANGE :   66 =    4.03MeV  to  167 =    4.26MeV
             AREA : Gross = 10457      Net = 9775      +/- 144
             CENTROID : 134.56  =    4.19MeV
             SHAPE : Fwhm =   0.09MeV    Fwtm =   0.16MeV

             ID : No close library match


ROI # 12-2   RANGE :  311 =    4.60MeV  to  417 =    4.84MeV
             AREA : Gross = 12002      Net = 11075     +/- 163
             CENTROID : 384.37  =    4.77MeV
             SHAPE : Fwhm =   0.10MeV    Fwtm =   0.16MeV

             ID : No close library match


ROI # 12-3   RANGE :  543 =    5.13MeV  to  654 =    5.39MeV
             AREA : Gross = 62078      Net = 60361     +/- 301
             CENTROID : 621.94  =    5.32MeV
             SHAPE : Fwhm =   0.10MeV    Fwtm =   0.17MeV

             ID : No close library match
```

420 Th RES.CHN

```
MCB # 2      ACQ 02-09-96  AT 11:41:03   RT : 80011.6    LT : 80000.0
             No detector description was entered
             NOPI-420-PWD Th RES 2/10/96

ROI #  2-1   RANGE :  156 =    3.94MeV  to  223 =    4.03MeV
             AREA : Gross = 327       Net = 170        +/- 42
             CENTROID : 202.54  =    4.00MeV
             SHAPE : Fwhm =   0.00MeV    Fwtm =   0.02MeV

             ID : No close library match

ROI #  2-2   RANGE :  592 =    4.52MeV  to  735 =    4.71MeV
             AREA : Gross = 15396     Net = 13115      +/- 256
             CENTROID : 703.12  =    4.67MeV
             SHAPE : Fwhm =   0.10MeV    Fwtm =   0.15MeV

             ID : No close library match

ROI #  2-3   RANGE : 1132 =    5.24MeV  to 1298 =    5.46MeV
             AREA : Gross = 52877     Net = 44303      +/- 524
             CENTROID : 1263.86 =    5.41MeV
             SHAPE : Fwhm =   0.06MeV    Fwtm =   0.17MeV

             ID : No close library match

ROI #  2-4   RANGE : 1380 =    5.57MeV  to 1503 =    5.73MeV
             AREA : Gross = 9736      Net = 6677       +/- 259
             CENTROID : 1465.26 =    5.68MeV
             SHAPE : Fwhm =   0.07MeV    Fwtm =   0.13MeV

             ID : No close library match
```

421U1E.CHN

```
MCB # 1       ACQ 02-13-96  AT 14:21:31   RT : 64637.1    LT : 64621.5
              No detector description was entered
              NOPI-421-PWD U IE 2/14/96

ROI #  7-1    RANGE :    98 =    4.12MeV  to  157 =    4.26MeV
              AREA : Gross = 321       Net = 262         +/- 28
              CENTROID : 134.41  =    4.21MeV
              SHAPE : Fwhm =   0.02MeV    Fwtm =   0.07MeV

              ID : No close library match


ROI #  7-2    RANGE :   343 =    4.69MeV  to  407 =    4.84MeV
              AREA : Gross = 340       Net = 259         +/- 32
              CENTROID : 387.95  =    4.80MeV
              SHAPE : Fwhm =   0.01MeV    Fwtm =   0.04MeV

              ID : No close library match


ROI #  7-3    RANGE :   545 =    5.16MeV  to  647 =    5.40MeV
              AREA : Gross = 45382     Net = 44506       +/- 242
              CENTROID : 623.52  =    5.35MeV
              SHAPE : Fwhm =   0.04MeV    Fwtm =   0.12MeV

              ID : No close library match
```

421ThIE.CHW

ICB # 1 ACQ 02-13-96 AT 14:21:31 RT : 64445.1 LT : 64429.5
No detector description was entered
NOPI-421-PWD Th IE 2/14/96

ROI # 4-1 RANGE : 89 = 3.93MeV to 131 = 4.04MeV
AREA : Gross = 15 Net = 15 +/- 4
Could not properly fit the peak.

ROI # 4-2 RANGE : 322 = 4.56MeV to 389 = 4.75MeV
AREA : Gross = 342 Net = 341 +/- 19
CENTROID : 368.90 = 4.69MeV
SHAPE : Fwhm = 0.04MeV Fwtm = 0.12MeV

ID : No close library match

ROI # 4-3 RANGE : 579 = 5.26MeV to 671 = 5.51MeV
AREA : Gross = 34245 Net = 33701 +/- 204
CENTROID : 646.78 = 5.45MeV
SHAPE : Fwhm = 0.04MeV Fwtm = 0.08MeV

ID : No close library match

ROI # 4-4 RANGE : 700 = 5.59MeV to 767 = 5.77MeV
AREA : Gross = 6306 Net = 6000 +/- 96
CENTROID : 744.68 = 5.71MeV
SHAPE : Fwhm = 0.05MeV Fwtm = 0.11MeV

ID : No close library match

421UAD.CHN

```
MCB # 1      ACQ 02-13-96  AT 14:21:31   RT : 64671.4    LT : 64655.7
             No detector description was entered
             NOPI-421-PWD U AD 2/14/96

ROI #  8-1   RANGE :   69 =     4.05MeV  to  157 =     4.25MeV
             AREA : Gross = 9225      Net = 8135       +/- 152
             CENTROID : 127.02  =    4.19MeV
             SHAPE : Fwhm =   0.09MeV    Fwtm =   0.16MeV

             ID : No close library match


ROI #  8-2   RANGE :  314 =     4.62MeV  to  408 =     4.84MeV
             AREA : Gross = 7027      Net = 6409       +/- 125
             CENTROID : 377.64  =    4.77MeV
             SHAPE : Fwhm =   0.10MeV    Fwtm =   0.17MeV

             ID : No close library match


ROI #  8-3   RANGE :  535 =     5.13MeV  to  648 =     5.40MeV
             AREA : Gross = 18404     Net = 17740      +/- 172
             CENTROID : 614.25  =    5.32MeV
             SHAPE : Fwhm =   0.10MeV    Fwtm =   0.17MeV

             ID : No close library match
```

421ThAD.CHN

```
MCB # 1       ACQ 02-13-96  AT 14:21:31   RT : 64485.8    LT : 64470.2
              No detector description was entered
              NOPI-421-PWD Th AD 2/14/96

ROI #  5-1    RANGE :   65 =    3.92MeV  to  117 =    4.05MeV
              AREA : Gross = 23        Net = 23          +/- 5
              Could not properly fit the peak.

ROI #  5-2    RANGE :  311 =    4.54MeV  to  396 =    4.76MeV
              AREA : Gross = 703       Net = 703         +/- 27
              CENTROID : 368.34  =    4.69MeV
              SHAPE : Fwhm =   0.02MeV    Fwtm =   0.07MeV

              ID : No close library match

ROI #  5-3    RANGE :  597 =    5.26MeV  to  695 =    5.51MeV
              AREA : Gross = 43303     Net = 42197       +/- 244
              CENTROID : 670.53  =    5.45MeV
              SHAPE : Fwhm =   0.04MeV    Fwtm =   0.14MeV

              ID : No close library match

ROI #  5-4    RANGE :  734 =    5.61MeV  to  798 =    5.77MeV
              AREA : Gross = 7215      Net = 6597        +/- 113
              CENTROID : 775.90  =    5.71MeV
              SHAPE : Fwhm =   0.06MeV    Fwtm =   0.11MeV

              ID : No close library match
```

421UAM.CHN

```
MCB # 1      ACQ 02-13-96  AT 14:21:31   RT : 64701.1    LT : 64685.5
             No detector description was entered
             NOPI-421-PWD U AM 2/14/96

ROI #  9-1   RANGE :    70 =    4.04MeV  to  162 =    4.25MeV
             AREA : Gross = 9525      Net = 7154       +/- 204
             CENTROID : 135.45  =    4.19MeV
             SHAPE : Fwhm =   0.09MeV    Fwtm =   0.15MeV

             ID : No close library match


ROI #  9-2   RANGE :   316 =    4.61MeV  to  410 =    4.83MeV
             AREA : Gross = 9610      Net = 6157       +/- 240
             CENTROID : 383.95  =    4.77MeV
             SHAPE : Fwhm =   0.08MeV    Fwtm =   0.16MeV

             ID : No close library match


ROI #  9-3   RANGE :   535 =    5.12MeV  to  651 =    5.39MeV
             AREA : Gross = 63552     Net = 54134      +/- 478
             CENTROID : 620.27  =    5.32MeV
             SHAPE : Fwhm =   0.10MeV    Fwtm =   0.17MeV

             ID : No close library match
```

421 Th AM.CHN

MCB # 1 ACQ 02-13-96 AT 14:21:31 RT : 50013.6 LT : 50000.0
No detector description was entered
NOPI-421-PWD Th AM 2/14/96

ROI # 6-1 RANGE : 57 = 3.90MeV to 108 = 4.04MeV
AREA : Gross = 286 Net = 156 +/- 34
CENTROID : 95.97 = 4.01MeV
SHAPE : Fwhm = 0.02MeV Fwtm = 0.06MeV

ID : No close library match

ROI # 6-2 RANGE : 252 = 4.44MeV to 356 = 4.72MeV
AREA : Gross = 42905 Net = 42539 +/- 220
CENTROID : 337.10 = 4.67MeV
SHAPE : Fwhm = 0.05MeV Fwtm = 0.13MeV

ID : No close library match

ROI 6-3 RANGE : 539 = 5.23MeV to 625 = 5.46MeV
AREA : Gross = 176409 Net = 172581 +/- 474
CENTROID : 604.65 = 5.41MeV
SHAPE : Fwhm = 0.04MeV Fwtm = 0.14MeV

ID : No close library match

ROI # 6-4 RANGE : 650 = 5.53MeV to 719 = 5.72MeV
AREA : Gross = 29237 Net = 27079 +/- 224
CENTROID : 697.31 = 5.66MeV
SHAPE : Fwhm = 0.06MeV Fwtm = 0.12MeV

ID : No close library match

421UCR.CHN

```
MCB # 1         ACQ 02-13-96  AT 14:21:32   RT : 64731.4    LT : 64715.8
                No detector description was entered
                NOPI-421-PWD U CR 2/14/96

ROI # 10-1      RANGE :    59 =     4.05MeV  to  150 =     4.27MeV
                AREA : Gross = 8943       Net = 7379        +/- 173
                CENTROID : 119.31  =    4.19MeV
                SHAPE : Fwhm =   0.09MeV    Fwtm =   0.16MeV

                ID : No close library match


ROI # 10-2      RANGE :   305 =     4.63MeV  to  402 =     4.86MeV
                AREA : Gross = 11036      Net = 9387        +/- 186
                CENTROID : 370.10  =    4.78MeV
                SHAPE : Fwhm =   0.10MeV    Fwtm =   0.16MeV

                ID : No close library match


ROI # 10-3      RANGE :   535 =     5.17MeV  to  637 =     5.41MeV
                AREA : Gross = 15361      Net = 13136       +/- 222
                CENTROID : 606.50  =    5.34MeV
                SHAPE : Fwhm =   0.10MeV    Fwtm =   0.17MeV

                ID : No close library match
```

421ThCR.CHW

```
MCB # 2     ACQ 02-13-96  AT 14:21:44   RT : 50011.6    LT : 50000.0
            No detector description was entered
            NOPI-421-PWD Th CR 2/14/96

ROI #  1-1  RANGE :  138 =    3.92MeV  to  218 =    4.03MeV
            AREA : Gross = 557       Net = 423        +/- 46
            CENTROID : 185.87  =    3.98MeV
            SHAPE : Fwhm =   0.02MeV    Fwtm =   0.06MeV

            ID : No close library match


ROI #  1-2  RANGE :  557 =    4.49MeV  to  724 =    4.72MeV
            AREA : Gross = 199688    Net = 197756     +/- 500
            CENTROID : 690.97  =    4.68MeV
            SHAPE : Fwhm =   0.05MeV    Fwtm =   0.13MeV

            ID : No close library match


ROI #  1-3  RANGE : 1115 =    5.26MeV  to 1278 =    5.48MeV
            AREA : Gross = 188192    Net = 183738     +/- 549
            CENTROID : 1244.77 =    5.43MeV
            SHAPE : Fwhm =   0.04MeV    Fwtm =   0.14MeV

            ID : No close library match


ROI #  1-4  RANGE : 1363 =    5.60MeV  to 1485 =    5.76MeV
            AREA : Gross = 29430     Net = 25271      +/- 326
            CENTROID : 1438.31 =    5.70MeV
            SHAPE : Fwhm =   0.06MeV    Fwtm =   0.12MeV

            ID : No close library match
```

4214 RES.CHN

MCB # 1 ACQ 02-13-96 AT 14:21:32 RT : 64758.7 LT : 64743.1
No detector description was entered
NOPI-421-PWD U RES 2/14/96

ROI # 11-1 RANGE : 88 = 4.08MeV to 169 = 4.27MeV
AREA : Gross = 2072 Net = 1990 +/- 55
CENTROID : 145.35 = 4.21MeV
SHAPE : Fwhm = 0.04MeV Fwtm = 0.11MeV

ID : No close library match

ROI # 11-2 RANGE : 339 = 4.66MeV to 417 = 4.84MeV
AREA : Gross = 3636 Net = 3478 +/- 73
CENTROID : 395.30 = 4.79MeV
SHAPE : Fwhm = 0.04MeV Fwtm = 0.11MeV

ID : No close library match

ROI # 11-3 RANGE : 564 = 5.18MeV to 657 = 5.39MeV
AREA : Gross = 58129 Net = 56421 +/- 285
CENTROID : 632.47 = 5.33MeV
SHAPE : Fwhm = 0.04MeV Fwtm = 0.13MeV

ID : No close library match

423ThIE2.CHN

```
MCB # 1     ACQ 02-09-96  AT 11:40:50   RT : 150028.1   LT : 150000.0
            No detector description was entered
            NOPI-423-PWD Th IE 2/12/96

ROI # 2-1   RANGE :  53 =   3.93MeV  to  91 =   4.03MeV
            AREA : Gross = 16       Net = 16       +/- 4
            Could not properly fit the peak.

ROI # 2-2   RANGE :  303 =   4.57MeV  to  364 =   4.73MeV
            AREA : Gross = 219      Net = 188      +/- 22
            Could not properly fit the peak.

ROI # 2-3   RANGE :  568 =   5.25MeV  to  665 =   5.49MeV
            AREA : Gross = 11194    Net = 10214    +/- 159
            CENTROID : 641.90  =   5.43MeV
            SHAPE : Fwhm =  0.04MeV   Fwtm =  0.14MeV

            ID : No close library match

ROI # 2-4   RANGE :  712 =   5.61MeV  to  770 =   5.76MeV
            AREA : Gross = 2928     Net = 2063     +/- 99
            CENTROID : 748.14  =   5.71MeV
            SHAPE : Fwhm =  0.05MeV   Fwtm =  0.11MeV

            ID : No close library match
```

421ThRES.CHN

```
MCB # 2      ACQ 02-13-96  AT 14:21:45   RT : 64591.7    LT : 64579.7
             No detector description was entered
             NOPI-421-PWD Th RES 2/14/96

ROI #  2-1   RANGE :  148 =    3.93MeV  to  229 =    4.03MeV
             AREA : Gross = 219       Net = 218        +/- 15
             CENTROID : 199.00  =    3.99MeV
             SHAPE : Fwhm =   0.00MeV    Fwtm =   0.03MeV

             ID : No close library match


ROI #  2-2   RANGE :  614 =    4.55MeV  to  739 =    4.71MeV
             AREA : Gross = 4192      Net = 4066       +/- 81
             CENTROID : 710.40  =    4.67MeV
             SHAPE : Fwhm =   0.04MeV    Fwtm =   0.12MeV

             ID : No close library match


ROI #  2-3   RANGE : 1138 =    5.24MeV  to 1312 =    5.48MeV
             AREA : Gross = 28147     Net = 27534      +/- 212
             CENTROID : 1271.02 =    5.42MeV
             SHAPE : Fwhm =   0.04MeV    Fwtm =   0.13MeV

             ID : No close library match


ROI #  2-4   RANGE : 1391 =    5.58MeV  to 1516 =    5.75MeV
             AREA : Gross = 6287      Net = 5680       +/- 133
             CENTROID : 1474.02 =    5.69MeV
             SHAPE : Fwhm =   0.06MeV    Fwtm =   0.11MeV

             ID : No close library match
```

423U1E2.CHN

```
MCB # 1      ACQ 02-09-96  AT 11:40:51   RT : 125027.9   LT : 125000.0
             No detector description was entered
             NOPI-423-PWD U IE 2/12/96

ROI #  7-1   RANGE :  106 =    4.14MeV  to  155 =    4.26MeV
             AREA : Gross = 260       Net = 211        +/- 24
             CENTROID : 137.39  =    4.21MeV
             SHAPE : Fwhm =   0.00MeV    Fwtm =   0.07MeV

             ID : No close library match


ROI #  7-2   RANGE :  344 =    4.70MeV  to  404 =    4.84MeV
             AREA : Gross = 288       Net = 242        +/- 26
             CENTROID : 386.06  =    4.79MeV
             SHAPE : Fwhm =   0.00MeV    Fwtm =   0.05MeV

             ID : No close library match


ROI #  7-3   RANGE :  544 =    5.16MeV  to  647 =    5.40MeV
             AREA : Gross = 21305     Net = 20821      +/- 169
             CENTROID : 622.47  =    5.34MeV
             SHAPE : Fwhm =   0.04MeV    Fwtm =   0.12MeV

             ID : No close library match
```

423U1E.CHW

```
MCB # 1        ACQ 01-17-96  AT 15:46:02   RT : 143967.4   LT : 143911.9
               No detector description was entered
               NOPI-423-PWD U IE 1/19/96

ROI # 12-1     RANGE :  114 =    4.14MeV  to  158 =    4.24MeV
               AREA : Gross = 442        Net = 293         +/- 36
               CENTROID : 142.99  =    4.21MeV
               SHAPE : Fwhm =   0.02MeV    Fwtm =   0.07MeV

               ID : No close library match


ROI # 12-2     RANGE :  366 =    4.72MeV  to  413 =    4.83MeV
               AREA : Gross = 459        Net = 228         +/- 43
               CENTROID : 394.85  =    4.79MeV
               SHAPE : Fwhm =   0.03MeV    Fwtm =   0.05MeV

               ID : No close library match


ROI # 12-3     RANGE :  576 =    5.21MeV  to  654 =    5.39MeV
               AREA : Gross = 29146      Net = 27395       +/- 221
               CENTROID : 630.66  =    5.34MeV
               SHAPE : Fwhm =   0.04MeV    Fwtm =   0.12MeV

               ID : No close library match
```

423UAD.CHW

```
MCB # 1      ACQ 01-17-96  AT 15:46:02   RT : 143967.3   LT : 143911.7
             No detector description was entered
             NOPI-423-PWD U AD 1/19/96

ROI # 13-1   RANGE :   52 =    4.03MeV  to  154 =    4.27MeV
             AREA : Gross = 16064     Net = 14244      +/- 209
             CENTROID : 125.61  =    4.20MeV
             SHAPE : Fwhm =   0.08MeV    Fwtm =   0.15MeV

             ID : No close library match


ROI # 13-2   RANGE :  299 =    4.60MeV  to  404 =    4.85MeV
             AREA : Gross = 13313     Net = 12023      +/- 183
             CENTROID : 375.25  =    4.78MeV
             SHAPE : Fwhm =   0.09MeV    Fwtm =   0.17MeV

             ID : No close library match


ROI # 13-3   RANGE :  564 =    5.22MeV  to  641 =    5.40MeV
             AREA : Gross = 24458     Net = 19700      +/- 277
             CENTROID : 612.54  =    5.33MeV
             SHAPE : Fwhm =   0.09MeV    Fwtm =   0.13MeV

             ID : No close library match
```

423 Th AD.CHN

```
MCB # 1      ACQ 01-19-96  AT 09:27:19   RT : 200006.3   LT : 200000.0
             No detector description was entered
             NOPI-423-PWD Th AD 01/23/96

ROI #  4-1   RANGE :   83 =    3.91MeV  to  138 =    4.06MeV
             AREA : Gross = 82         Net = 68          +/- 14
             CENTROID : 106.09  =    3.97MeV
             SHAPE : Fwhm =   0.00MeV    Fwtm =   0.01MeV

             ID : No close library match


ROI #  4-2   RANGE :  293 =    4.48MeV  to  388 =    4.74MeV
             AREA : Gross = 2632       Net = 2368        +/- 80
             CENTROID : 367.27  =    4.69MeV
             SHAPE : Fwhm =   0.04MeV    Fwtm =   0.16MeV

             ID : No close library match


ROI #  4-3   RANGE :  572 =    5.24MeV  to  673 =    5.52MeV
             AREA : Gross = 38027      Net = 35681       +/- 271
             CENTROID : 644.76  =    5.44MeV
             SHAPE : Fwhm =   0.05MeV    Fwtm =   0.16MeV

             ID : No close library match


ROI #  4-4   RANGE :  689 =    5.56MeV  to  770 =    5.78MeV
             AREA : Gross = 22819      Net = 21343       +/- 200
             CENTROID : 745.23  =    5.72MeV
             SHAPE : Fwhm =   0.05MeV    Fwtm =   0.13MeV

             ID : No close library match
```

423UAM.CHN

```
MCB # 1      ACQ 01-17-96  AT 15:46:02   RT : 143967.1   LT : 143911.6
             No detector description was entered
             NOPI-423-PWD U AM 1/19/96

ROI # 14-1   RANGE :   70 =    4.05MeV  to  157 =    4.25MeV
             AREA : Gross = 14719     Net = 14309      +/- 141
             CENTROID : 131.94  =    4.19MeV
             SHAPE : Fwhm =   0.07MeV    Fwtm =   0.13MeV

             ID : No close library match


ROI # 14-2   RANGE :  321 =    4.63MeV  to  411 =    4.84MeV
             AREA : Gross = 12794     Net = 12188      +/- 144
             CENTROID : 383.29  =    4.78MeV
             SHAPE : Fwhm =   0.08MeV    Fwtm =   0.13MeV

             ID : No close library match


ROI # 14-3   RANGE :  565 =    5.20MeV  to  647 =    5.40MeV
             AREA : Gross = 40751     Net = 38358      +/- 263
             CENTROID : 625.10  =    5.34MeV
             SHAPE : Fwhm =   0.09MeV    Fwtm =   0.13MeV

             ID : No close library match
```

423 Th AM.CHN

MCA # 1 ACQ 01-19-96 AT 09:27:19 RT : 80004.8 LT : 80000.0
No detector description was entered
NOPI-423-PWD Th AM 01/23/96

ROI # 5-1 RANGE : 59 = 3.90MeV to 116 = 4.05MeV
AREA : Gross = 684 Net = 520 +/- 44
CENTROID : 97.50 = 4.00MeV
SHAPE : Fwhm = 0.03MeV Fwtm = 0.10MeV

ID : No close library match

ROI # 5-2 RANGE : 276 = 4.45MeV to 387 = 4.73MeV
AREA : Gross = 23064 Net = 22652 +/- 173
CENTROID : 365.39 = 4.68MeV
SHAPE : Fwhm = 0.10MeV Fwtm = 0.17MeV

ID : No close library match

ROI # 5-3 RANGE : 573 = 5.20MeV to 692 = 5.50MeV
AREA : Gross = 34173 Net = 32532 +/- 252
CENTROID : 663.09 = 5.43MeV
SHAPE : Fwhm = 0.05MeV Fwtm = 0.17MeV

ID : No close library match

ROI # 5-4 RANGE : 711 = 5.55MeV to 796 = 5.77MeV
AREA : Gross = 16162 Net = 15001 +/- 175
CENTROID : 769.23 = 5.70MeV
SHAPE : Fwhm = 0.06MeV Fwtm = 0.13MeV

ID : No close library match

423UCR.CHW

```
MCB # 1      ACQ 01-17-96  AT 15:46:02   RT : 143967.0   LT : 143911.4
             No detector description was entered
             NOPI-423-PWD U CR 1/19/96

ROI # 15-1   RANGE :   68 =    4.06MeV  to  158 =    4.27MeV
             AREA : Gross = 11647     Net = 10676      +/- 156
             CENTROID : 129.29  =    4.21MeV
             SHAPE : Fwhm =   0.07MeV    Fwtm =   0.13MeV

             ID : No close library match


ROI # 15-2   RANGE :  305 =    4.62MeV  to  408 =    4.86MeV
             AREA : Gross = 15300     Net = 14347      +/- 173
             CENTROID : 379.52  =    4.79MeV
             SHAPE : Fwhm =   0.08MeV    Fwtm =   0.15MeV

             ID : No close library match


ROI # 15-3   RANGE :  550 =    5.19MeV  to  643 =    5.40MeV
             AREA : Gross = 20314     Net = 18826      +/- 202
             CENTROID : 618.73  =    5.35MeV
             SHAPE : Fwhm =   0.08MeV    Fwtm =   0.14MeV

             ID : No close library match
```

423ThCR.CHN

```
MCB # 1      ACQ 01-19-96  AT 09:27:19   RT : 25002.7    LT : 25000.0
             No detector description was entered
             NOPI-423-PWD Th CR 01/23/96

ROI #  6-1   RANGE :   52 =    3.89MeV  to  109 =    4.04MeV
             AREA : Gross = 562       Net = 437        +/- 39
             CENTROID : 90.59   =    3.99MeV
             SHAPE : Fwhm =   0.01MeV    Fwtm =   0.13MeV

             ID : No close library match


ROI #  6-2   RANGE :  227 =    4.37MeV  to  356 =    4.72MeV
             AREA : Gross = 31456     Net = 30893      +/- 206
             CENTROID : 335.61  =    4.67MeV
             SHAPE : Fwhm =   0.10MeV    Fwtm =   0.18MeV

             ID : No close library match


ROI #  6-3   RANGE :  512 =    5.15MeV  to  626 =    5.47MeV
             AREA : Gross = 24494     Net = 23115      +/- 219
             CENTROID : 603.56  =    5.40MeV
             SHAPE : Fwhm =   0.06MeV    Fwtm =   0.18MeV

             ID : No close library match


ROI #  6-4   RANGE :  641 =    5.51MeV  to  722 =    5.73MeV
             AREA : Gross = 8565      Net = 7445       +/- 147
             CENTROID : 697.78  =    5.66MeV
             SHAPE : Fwhm =   0.06MeV    Fwtm =   0.13MeV

             ID : No close library match
```

423URES.CHN

MC 1 ACQ 01-17-96 AT 15:46:02 RT : 143966.8 LT : 143911.3
No detector description was entered
NOPI-423-PWD U RES 1/19/96

ROI # 16-1
RANGE : 48 = 4.01MeV to 164 = 4.27MeV
AREA : Gross = 9454 Net = 8616 +/- 155
CENTROID : 122.94 = 4.18MeV
SHAPE : Fwhm = 0.13MeV Fwtm = 0.20MeV

ID : No close library match

ROI # 16-2
RANGE : 291 = 4.56MeV to 414 = 4.84MeV
AREA : Gross = 10482 Net = 9924 +/- 145
CENTROID : 374.87 = 4.75MeV
SHAPE : Fwhm = 0.12MeV Fwtm = 0.20MeV

ID : No close library match

ROI # 16-3
RANGE : 524 = 5.09MeV to 654 = 5.38MeV
AREA : Gross = 29896 Net = 28389 +/- 245
CENTROID : 612.90 = 5.29MeV
SHAPE : Fwhm = 0.12MeV Fwtm = 0.19MeV

ID : No close library match

423ThRES.CHN

MCB # 2   ACQ 01-19-96 AT 09:27:38   RT : 344272.3   LT : 344230.2
No detector description was entered
NOPI-423-PWD Th RES 01/23/96

ROI # 1-1   RANGE : 125 =   3.90MeV to 216 =   4.03MeV
AREA : Gross = 236   Net = 213   +/- 23
CENTROID : 182.92 =   3.98MeV
SHAPE : Fwhm =   0.00MeV   Fwtm =   0.06MeV

ID : No close library match

ROI # 1-2   RANGE : 567 =   4.51MeV to 715 =   4.71MeV
AREA : Gross = 4409   Net = 4260   +/- 88
CENTROID : 686.57 =   4.67MeV
SHAPE : Fwhm =   0.04MeV   Fwtm =   0.12MeV

ID : No close library match

ROI # 1-3   RANGE : 1118 =   5.26MeV to 1279 =   5.48MeV
AREA : Gross = 7317   Net = 6670   +/- 153
CENTROID : 1234.72 =   5.42MeV
SHAPE : Fwhm =   0.04MeV   Fwtm =   0.15MeV

ID : No close library match

ROI # 1-4   RANGE : 1346 =   5.57MeV to 1473 =   5.75MeV
AREA : Gross = 7169   Net = 6637   +/- 132
CENTROID : 1435.72 =   5.70MeV
SHAPE : Fwhm =   0.05MeV   Fwtm =   0.10MeV

ID : No close library match

425U1E.CHN

```
MCB # 1       ACQ 02-07-96  AT 15:12:57   RT : 64471.7    LT : 64454.4
              No detector description was entered
              NOPI-425-PWD U IE 2/8/96

ROI #  8-1    RANGE :  104 =    4.13MeV  to  161 =    4.26MeV
              AREA : Gross = 228        Net = 112        +/- 33
              CENTROID : 141.83  =    4.22MeV
              SHAPE : Fwhm =   0.00MeV    Fwtm =   0.02MeV

              ID : No close library match


ROI #  8-2    RANGE :  325 =    4.65MeV  to  403 =    4.83MeV
              AREA : Gross = 438        Net = 138        +/- 62
              Could not properly fit the peak.

ROI #  8-3    RANGE :  562 =    5.20MeV  to  651 =    5.40MeV
              AREA : Gross = 35969      Net = 34244      +/- 242
              CENTROID : 625.36  =    5.35MeV
              SHAPE : Fwhm =   0.04MeV    Fwtm =   0.12MeV

              ID : No close library match
```

425Th1E.CHW

MC[illegible] 1 ACQ 02-07-96 AT 15:12:57 RT : 64227.2 LT : 64210.0
No detector description was entered
NOPI-425-PWD Th IE 2/8/96

ROI # 5-1 RANGE : 322 = 4.57MeV to 386 = 4.73MeV
AREA : Gross = 119 Net = 118 +/- 11
CENTROID : 372.83 = 4.70MeV
SHAPE : Fwhm = 0.00MeV Fwtm = 0.03MeV

ID : No close library match

ROI # 5-2 RANGE : 593 = 5.25MeV to 695 = 5.51MeV
AREA : Gross = 33317 Net = 32459 +/- 215
CENTROID : 669.34 = 5.45MeV
SHAPE : Fwhm = 0.04MeV Fwtm = 0.14MeV

ID : No close library match

ROI # 5-3 RANGE : 723 = 5.58MeV to 798 = 5.77MeV
AREA : Gross = 5963 Net = 5569 +/- 101
CENTROID : 773.37 = 5.71MeV
SHAPE : Fwhm = 0.05MeV Fwtm = 0.11MeV

ID : No close library match

```
ICB # 1        ACQ 02-07-96  AT 15:12:57   RT : 64227.2    LT : 64210.0
               No detector description was entered
               NOPI-425-PWD Th IE 2/8/96

ROI #  5-1     RANGE :   67 =    3.92MeV  to  105 =    4.02MeV
               AREA : Gross = 3         Net = 3          +/- 2
               Could not properly fit the peak.
```

425UADLHN

```
MCB # 1      ACQ 02-07-96  AT 15:12:58   RT : 64507.1    LT : 64489.9
             No detector description was entered
             NOPI-425-PWD U AD 2/8/96

ROI #  9-1   RANGE :   47 =    3.99MeV  to  166 =    4.26MeV
             AREA : Gross = 9292      Net = 8992       +/- 121
             CENTROID : 135.58  =    4.19MeV
             SHAPE : Fwhm =   0.08MeV    Fwtm =   0.16MeV

             ID : No close library match


ROI #  9-2   RANGE :  297 =    4.57MeV  to  413 =    4.84MeV
             AREA : Gross = 8591      Net = 8259       +/- 120
             CENTROID : 385.67  =    4.78MeV
             SHAPE : Fwhm =   0.09MeV    Fwtm =   0.16MeV

             ID : No close library match


ROI #  9-3   RANGE :  560 =    5.18MeV  to  650 =    5.39MeV
             AREA : Gross = 46279     Net = 42655      +/- 307
             CENTROID : 623.83  =    5.33MeV
             SHAPE : Fwhm =   0.09MeV    Fwtm =   0.15MeV

             ID : No close library match
```

425ThAD.CHW

```
MCB # 1     ACQ 02-07-96  AT 15:12:57   RT : 64270.9    LT : 64253.7
            No detector description was entered
            NOPI-425-PWD Th AD 2/8/96

ROI #  6-1  RANGE :   69 =    3.93MeV  to  106 =    4.03MeV
            AREA : Gross = 24       Net = 5          +/- 10
            Could not properly fit the peak.

ROI #  6-2  RANGE :  283 =    4.52MeV  to  353 =    4.71MeV
            AREA : Gross = 929      Net = 911        +/- 33
            CENTROID : 339.77  =    4.68MeV
            SHAPE : Fwhm =   0.05MeV    Fwtm =   0.12MeV

            ID : No close library match

ROI #  6-3  RANGE :  535 =    5.22MeV  to  628 =    5.47MeV
            AREA : Gross = 41476    Net = 40519      +/- 234
            CENTROID : 604.90  =    5.41MeV
            SHAPE : Fwhm =   0.04MeV    Fwtm =   0.14MeV

            ID : No close library match

ROI #  6-4  RANGE :  651 =    5.54MeV  to  723 =    5.73MeV
            AREA : Gross = 7796     Net = 7223       +/- 117
            CENTROID : 698.10  =    5.66MeV
            SHAPE : Fwhm =   0.06MeV    Fwtm =   0.12MeV

            ID : No close library match
```

425 uAm2.cHn

```
MCB # 1     ACQ 02-14-96   AT 14:00:31   RT : 65017.7    LT : 65008.2
            No detector description was entered
            NOPI-425-PWD U CR 2/15/96

ROI #  8-1  RANGE :    70 =     4.05MeV  to   159 =     4.26MeV
            AREA : Gross = 6942       Net = 5381        +/- 165
            CENTROID : 129.95  =    4.19MeV
            SHAPE : Fwhm =   0.07MeV    Fwtm =   0.14MeV

            ID : No close library match


ROI #  8-2  RANGE :   322 =     4.64MeV  to   406 =     4.83MeV
            AREA : Gross = 7150       Net = 4715        +/- 192
            CENTROID : 381.00  =    4.78MeV
            SHAPE : Fwhm =   0.09MeV    Fwtm =   0.14MeV

            ID : No close library match


ROI #  8-3  RANGE :   549 =     5.17MeV  to   651 =     5.40MeV
            AREA : Gross = 195811     Net = 185546      +/- 593
            CENTROID : 619.79  =    5.33MeV
            SHAPE : Fwhm =   0.10MeV    Fwtm =   0.16MeV

            ID : No close library match
```

425ThAM2.CHN

MCA # 2 ACQ 02-14-96 AT 13:59:37 RT : 64991.7 LT : 64968.2
No detector description was entered
NOPI-425-PWD Th AM 2/15/96

ROI # 2-1 RANGE : 147 = 3.93MeV to 229 = 4.03MeV
AREA : Gross = 307 Net = 237 +/- 34
CENTROID : 196.07 = 3.99MeV
SHAPE : Fwhm = 0.00MeV Fwtm = 0.03MeV

ID : No close library match

ROI # 2-2 RANGE : 580 = 4.50MeV to 741 = 4.72MeV
AREA : Gross = 13903 Net = 13498 +/- 155
CENTROID : 708.97 = 4.67MeV
SHAPE : Fwhm = 0.04MeV Fwtm = 0.13MeV

ID : No close library match

ROI # 2-3 RANGE : 1126 = 5.23MeV to 1313 = 5.48MeV
AREA : Gross = 198545 Net = 193845 +/- 580
CENTROID : 1269.77 = 5.42MeV
SHAPE : Fwhm = 0.04MeV Fwtm = 0.14MeV

ID : No close library match

ROI # 2-4 RANGE : 1363 = 5.54MeV to 1508 = 5.74MeV
AREA : Gross = 33211 Net = 31409 +/- 271
CENTROID : 1465.30 = 5.68MeV
SHAPE : Fwhm = 0.06MeV Fwtm = 0.12MeV

ID : No close library match

425 U AM.CHN

MCB # 1	ACQ 02-07-96 AT 15:12:58 RT : 64536.0 LT : 64518.8 No detector description was entered NOPI-425-PWD U AM 2/8/96	

```
MCB # 1       ACQ 02-07-96  AT 15:12:58   RT : 64536.0    LT : 64518.8
              No detector description was entered
              NOPI-425-PWD U AM 2/8/96

ROI # 10-1    RANGE :    55 =     4.04MeV  to  150 =    4.27MeV
              AREA : Gross = 7583       Net = 7295       +/- 108
              CENTROID : 123.76  =    4.20MeV
              SHAPE : Fwhm =    0.08MeV    Fwtm =   0.15MeV

              ID : No close library match


ROI # 10-2    RANGE :   315 =     4.65MeV  to  401 =    4.86MeV
              AREA : Gross = 7272       Net = 6720       +/- 119
              CENTROID : 372.89  =    4.79MeV
              SHAPE : Fwhm =    0.09MeV    Fwtm =   0.14MeV

              ID : No close library match


ROI # 10-3    RANGE :   529 =     5.16MeV  to  642 =    5.42MeV
              AREA : Gross = 279078     Net = 275145     +/- 588
              CENTROID : 611.77  =    5.35MeV
              SHAPE : Fwhm =    0.10MeV    Fwtm =   0.15MeV

              ID : No close library match
```

425uCR.ctw

```
MCB # 1      ACQ 02-07-96  AT 15:12:58   RT : 64570.3    LT : 64553.1
             No detector description was entered
             NOPI-425-PWD U CR 2/8/96

ROI # 11-1   RANGE :   64 =    4.03MeV  to  168 =    4.27MeV
             AREA : Gross = 7422      Net = 7107       +/- 111
             CENTROID : 139.75  =    4.20MeV
             SHAPE : Fwhm =   0.09MeV    Fwtm =   0.16MeV

             ID : No close library match


ROI # 11-2   RANGE :  311 =    4.60MeV  to  417 =    4.84MeV
             AREA : Gross = 9357      Net = 8875       +/- 130
             CENTROID : 386.95  =    4.77MeV
             SHAPE : Fwhm =   0.09MeV    Fwtm =   0.17MeV

             ID : No close library match


ROI # 11-3   RANGE :  538 =    5.12MeV  to  657 =    5.39MeV
             AREA : Gross = 58124     Net = 56204      +/- 304
             CENTROID : 624.85  =    5.32MeV
             SHAPE : Fwhm =   0.10MeV    Fwtm =   0.17MeV

             ID : No close library match
```

425Th CR.CHN

```
MCB # 2      ACQ 02-10-96  AT 10:58:13   RT : 80013.1    LT : 80000.0
             No detector description was entered
             NOPI-425-PWD Th CR 2/12/96

ROI #  2-1   RANGE :  158 =    3.94MeV  to  220 =    4.02MeV
             AREA : Gross = 499       Net = 161        +/- 58
             CENTROID : 190.82  =    3.98MeV
             SHAPE : Fwhm =   0.00MeV    Fwtm =   0.03MeV

             ID : No close library match


ROI #  2-2   RANGE :  521 =    4.42MeV  to  736 =    4.71MeV
             AREA : Gross = 48052     Net = 44164      +/- 425
             CENTROID : 702.20  =    4.66MeV
             SHAPE : Fwhm =   0.11MeV    Fwtm =   0.19MeV

             ID : No close library match


ROI #  2-3   RANGE : 1017 =    5.08MeV  to 1302 =    5.46MeV
             AREA : Gross = 200062    Net = 166600     +/- 1315
             Could not properly fit the peak.

ROI #  2-4   RANGE : 1344 =    5.52MeV  to 1503 =    5.73MeV
             AREA : Gross = 71942     Net = 46822      +/- 832
             CENTROID : 1454.66 =    5.67MeV
             SHAPE : Fwhm =   0.10MeV    Fwtm =   0.17MeV

             ID : No close library match
```

425URES.CHN

MC 1 ACQ 02-07-96 AT 15:12:58 RT : 64596.8 LT : 64579.5
No detector description was entered
NOPI-425-PWD U RES 2/8/96

ROI # 12-1 RANGE : 104 = 4.12MeV to 164 = 4.26MeV
AREA : Gross = 2040 Net = 1613 +/- 74
CENTROID : 141.69 = 4.20MeV
SHAPE : Fwhm = 0.04MeV Fwtm = 0.10MeV

ID : No close library match

ROI # 12-2 RANGE : 345 = 4.68MeV to 413 = 4.83MeV
AREA : Gross = 1955 Net = 1620 +/- 72
CENTROID : 392.98 = 4.79MeV
SHAPE : Fwhm = 0.04MeV Fwtm = 0.11MeV

ID : No close library match

ROI # 12-3 RANGE : 563 = 5.18MeV to 657 = 5.40MeV
AREA : Gross = 56711 Net = 55428 +/- 273
CENTROID : 630.71 = 5.34MeV
SHAPE : Fwhm = 0.04MeV Fwtm = 0.12MeV

ID : No close library match

425 Th RES.CHN

```
MCB # 2      ACQ 02-07-96  AT 15:13:18   RT : 64349.2    LT : 64347.2
             No detector description was entered
             NOPI-425-PWD Th RES 2/8/96

ROI #  2-1   RANGE :  132 =    3.91MeV  to  220 =    4.02MeV
             AREA : Gross = 374       Net = 287        +/- 39
             CENTROID : 208.80  =    4.01MeV
             SHAPE : Fwhm =   0.01MeV    Fwtm =   0.04MeV

             ID : No close library match


ROI #  2-2   RANGE :  618 =    4.55MeV  to  734 =    4.71MeV
             AREA : Gross = 2611      Net = 2418       +/- 77
             CENTROID : 709.60  =    4.67MeV
             SHAPE : Fwhm =   0.04MeV    Fwtm =   0.11MeV

             ID : No close library match


ROI #  2-3   RANGE : 1135 =    5.24MeV  to 1309 =    5.47MeV
             AREA : Gross = 42614     Net = 41070      +/- 291
             CENTROID : 1269.00 =    5.42MeV
             SHAPE : Fwhm =   0.04MeV    Fwtm =   0.14MeV

             ID : No close library match


ROI #  2-4   RANGE : 1371 =    5.55MeV  to 1501 =    5.73MeV
             AREA : Gross = 7684      Net = 6930       +/- 150
             CENTROID : 1463.94 =    5.68MeV
             SHAPE : Fwhm =   0.05MeV    Fwtm =   0.13MeV

             ID : No close library match
```

425IEU3.CHW

```
MCB # 1        ACQ 07-17-96   AT 08:53:13    RT : 81297.3     LT : 81259.4
               No detector description was entered
               NOPI-425-PWD IE U 7/18/96

ROI #   7-1    RANGE :    79 =     4.08MeV  to  152 =     4.25MeV
               AREA : Gross = 4810       Net = 4540        +/- 87
               CENTROID : 130.75  =     4.20MeV
               SHAPE : Fwhm =    0.07MeV    Fwtm =    0.13MeV

               ID : No close library match

ROI #   7-2    RANGE :   329 =     4.66MeV  to  403 =     4.83MeV
               AREA : Gross = 3947       Net = 3633        +/- 85
               CENTROID : 380.51  =     4.78MeV
               SHAPE : Fwhm =    0.07MeV    Fwtm =    0.12MeV

               ID : No close library match

ROI #   7-3    RANGE :   562 =     5.20MeV  to  639 =     5.38MeV
               AREA : Gross = 5883       Net = 5610        +/- 94
               CENTROID : 616.72  =     5.33MeV
               SHAPE : Fwhm =    0.08MeV    Fwtm =    0.13MeV

               ID : No close library match
```

425IETh3.CHN

```
MCB # 1      ACQ 07-19-96  AT 09:54:22   RT : 100027.1   LT : 100000.0
             No detector description was entered
             NOPI-425-PWD IE TH 7/22/96

ROI #  2-1   RANGE :   51 =    3.93MeV  to   89 =    4.03MeV
             AREA : Gross = 26        Net = 25        +/- 6
             CENTROID : 56.00   =    3.94MeV
             SHAPE : Fwhm =   0.01MeV    Fwtm =   0.01MeV

             ID : No close library match


ROI #  2-2   RANGE :  323 =    4.62MeV  to  361 =    4.72MeV
             AREA : Gross = 195       Net = 118       +/- 23
             CENTROID : 345.39  =    4.68MeV
             SHAPE : Fwhm =   0.01MeV    Fwtm =   0.03MeV

             ID : No close library match


ROI #  2-3   RANGE :  572 =    5.26MeV  to  668 =    5.50MeV
             AREA : Gross = 14952     Net = 14224     +/- 159
             CENTROID : 640.36  =    5.43MeV
             SHAPE : Fwhm =   0.04MeV    Fwtm =   0.14MeV

             ID : No close library match


ROI #  2-4   RANGE :  690 =    5.56MeV  to  773 =    5.77MeV
             AREA : Gross = 17307     Net = 16314     +/- 171
             CENTROID : 745.30  =    5.70MeV
             SHAPE : Fwhm =   0.05MeV    Fwtm =   0.12MeV

             ID : No close library match
```

425ADU3.CHN

```
MCB # 1      ACQ 07-17-96  AT 08:53:13   RT : 81328.5    LT : 81290.7
             No detector description was entered
             NOPI-425-PWD AD U 7/18/96

ROI #  8-1   RANGE :   83 =    4.08MeV  to  151 =    4.24MeV
             AREA : Gross = 4131      Net = 3052      +/- 120
             CENTROID : 131.73  =    4.20MeV
             SHAPE : Fwhm =   0.06MeV    Fwtm =   0.13MeV

             ID : No close library match


ROI #  8-2   RANGE :  328 =    4.65MeV  to  403 =    4.83MeV
             AREA : Gross = 4572      Net = 2596      +/- 160
             CENTROID : 381.90  =    4.78MeV
             SHAPE : Fwhm =   0.07MeV    Fwtm =   0.13MeV

             ID : No close library match


ROI #  8-3   RANGE :  553 =    5.18MeV  to  644 =    5.39MeV
             AREA : Gross = 174361    Net = 165589    +/- 540
             CENTROID : 620.05  =    5.33MeV
             SHAPE : Fwhm =   0.09MeV    Fwtm =   0.14MeV

             ID : No close library match
```

425ADTh3.CHN

MCB # 1 ACQ 07-19-96 AT 09:54:23 RT : 50026.4 LT : 50000.0
No detector description was entered
NOPI-425-PWD AD TH 7/22/96

ROI # 4-1 RANGE : 86 = 3.92MeV to 126 = 4.03MeV
AREA : Gross = 233 Net = 68 +/- 32
CENTROID : 114.38 = 4.00MeV
SHAPE : Fwhm = 0.01MeV Fwtm = 0.01MeV

ID : No close library match

ROI # 4-2 RANGE : 310 = 4.53MeV to 379 = 4.72MeV
AREA : Gross = 3360 Net = 2905 +/- 88
CENTROID : 362.15 = 4.67MeV
SHAPE : Fwhm = 0.05MeV Fwtm = 0.14MeV

ID : No close library match

ROI # 4-3 RANGE : 565 = 5.22MeV to 663 = 5.49MeV
AREA : Gross = 263276 Net = 251725 +/- 656
CENTROID : 639.35 = 5.43MeV
SHAPE : Fwhm = 0.05MeV Fwtm = 0.15MeV

ID : No close library match

ROI # 4-4 RANGE : 681 = 5.54MeV to 760 = 5.76MeV
AREA : Gross = 236490 Net = 222530 +/- 628
CENTROID : 736.07 = 5.69MeV
SHAPE : Fwhm = 0.07MeV Fwtm = 0.13MeV

ID : No close library match

425AMU3.CHN

```
MCB # 1        ACQ 07-17-96  AT 08:53:13   RT : 81360.5     LT : 81322.6
               No detector description was entered
               NOPI-425-PWD AM U 7/18/96

ROI #  9-1     RANGE :    90 =     4.09MeV  to  158 =     4.24MeV
               AREA : Gross = 4830       Net = 4511       +/- 89
               CENTROID : 138.73  =     4.20MeV
               SHAPE : Fwhm =   0.06MeV    Fwtm =   0.11MeV

               ID : No close library match


ROI #  9-2     RANGE :   347 =     4.69MeV  to  407 =     4.82MeV
               AREA : Gross = 4444       Net = 4005       +/- 90
               CENTROID : 388.44  =     4.78MeV
               SHAPE : Fwhm =   0.04MeV    Fwtm =   0.11MeV

               ID : No close library match


ROI #  9-3     RANGE :   562 =     5.19MeV  to  650 =     5.39MeV
               AREA : Gross = 76011      Net = 74290      +/- 313
               CENTROID : 624.55  =     5.33MeV
               SHAPE : Fwhm =   0.05MeV    Fwtm =   0.13MeV

               ID : No close library match
```

425AMTh8.CHN

```
MCB # 1     ACQ 07-19-96  AT 09:54:23   RT : 40022.6    LT : 40000.0
            No detector description was entered
            NOPI-425-PWD AM TH 7/22/96

ROI #  5-1  RANGE :   79 =    3.95MeV  to  111 =    4.04MeV
            AREA : Gross = 214       Net = 82          +/- 26
            CENTROID : 101.55  =    4.01MeV
            SHAPE : Fwhm =   0.01MeV    Fwtm =   0.02MeV

            ID : No close library match


ROI #  5-2  RANGE :  309 =    4.54MeV  to  386 =    4.73MeV
            AREA : Gross = 6812      Net = 6317        +/- 111
            CENTROID : 365.18  =    4.68MeV
            SHAPE : Fwhm =   0.05MeV    Fwtm =   0.13MeV

            ID : No close library match


ROI    5-3  RANGE :  592 =    5.25MeV  to  693 =    5.51MeV
            AREA : Gross = 89337     Net = 85703       +/- 379
            CENTROID : 667.62  =    5.44MeV
            SHAPE : Fwhm =   0.04MeV    Fwtm =   0.15MeV

            ID : No close library match


ROI #  5-4  RANGE :  710 =    5.55MeV  to  797 =    5.77MeV
            AREA : Gross = 81533     Net = 77793       +/- 359
            CENTROID : 771.96  =    5.70MeV
            SHAPE : Fwhm =   0.06MeV    Fwtm =   0.12MeV

            ID : No close library match
```

425CRU3.CHN

MCB # 1	ACQ 07-17-96 AT 08:53:13 RT : 81389.4 LT : 81351.6 No detector description was entered NOPI-425-PWD CR U 7/18/96
ROI # 10-1	RANGE : 65 = 4.07MeV to 146 = 4.26MeV AREA : Gross = 11295 Net = 10818 +/- 130 CENTROID : 120.53 = 4.20MeV SHAPE : Fwhm = 0.07MeV Fwtm = 0.14MeV ID : No close library match
ROI # 10-2	RANGE : 314 = 4.65MeV to 395 = 4.84MeV AREA : Gross = 14356 Net = 13782 +/- 145 CENTROID : 369.57 = 4.78MeV SHAPE : Fwhm = 0.08MeV Fwtm = 0.14MeV ID : No close library match
ROI # 10-3	RANGE : 554 = 5.22MeV to 633 = 5.40MeV AREA : Gross = 10390 Net = 9457 +/- 145 CENTROID : 607.87 = 5.34MeV SHAPE : Fwhm = 0.08MeV Fwtm = 0.14MeV ID : No close library match

425CRTh3.CHN

```
MCB # 1       ACQ 07-19-96  AT 09:54:23   RT : 40022.6    LT : 40000.0
              No detector description was entered
              NOPI-425-PWD CR TH 7/22/96

ROI #  6-1    RANGE :   60 =     3.91MeV  to  108 =     4.04MeV
              AREA : Gross = 360        Net = 269         +/- 30
              CENTROID : 87.94   =     3.98MeV
              SHAPE : Fwhm =   0.04MeV    Fwtm =   0.10MeV

              ID : No close library match


ROI #  6-2    RANGE :  265 =     4.47MeV  to  354 =     4.72MeV
              AREA : Gross = 35744      Net = 34318       +/- 233
              CENTROID : 333.34  =    4.66MeV
              SHAPE : Fwhm =   0.09MeV    Fwtm =   0.16MeV

              ID : No close library match


ROI #  6-3    RANGE :  531 =     5.20MeV  to  622 =     5.46MeV
              AREA : Gross = 18267      Net = 16703       +/- 198
              CENTROID : 600.36  =    5.40MeV
              SHAPE : Fwhm =   0.05MeV    Fwtm =   0.16MeV

              ID : No close library match


ROI #  6-4    RANGE :  650 =     5.53MeV  to  718 =     5.72MeV
              AREA : Gross = 16209      Net = 13346       +/- 208
              CENTROID : 692.28  =    5.65MeV
              SHAPE : Fwhm =   0.07MeV    Fwtm =   0.13MeV

              ID : No close library match
```

425RESU3.CHW

ICB # 1	ACQ 07-17-96 AT 08:53:13 RT : 81420.0 LT : 81382.1 No detector description was entered NOPI-425-PWD RES U 7/18/96
ROI # 11-1	RANGE : 95 = 4.10MeV to 160 = 4.25MeV AREA : Gross = 2477 Net = 2246 +/- 67 CENTROID : 139.14 = 4.20MeV SHAPE : Fwhm = 0.05MeV Fwtm = 0.10MeV ID : No close library match
ROI # 11-2	RANGE : 345 = 4.67MeV to 408 = 4.82MeV AREA : Gross = 1946 Net = 1809 +/- 56 CENTROID : 390.45 = 4.78MeV SHAPE : Fwhm = 0.05MeV Fwtm = 0.12MeV ID : No close library match
ROI # 11-3	RANGE : 573 = 5.20MeV to 651 = 5.38MeV AREA : Gross = 15305 Net = 14515 +/- 155 CENTROID : 626.94 = 5.32MeV SHAPE : Fwhm = 0.05MeV Fwtm = 0.13MeV ID : No close library match

425 RTh3.CHN

ICB # 1 ACQ 07-22-96 AT 07:31:28 RT : 60002.8 LT : 60000.0
No detector description was entered
NOPI-425-PWD RES Th 7/23/96

ROI # 2-1 RANGE : 50 = 3.93MeV to 93 = 4.04MeV
AREA : Gross = 316 Net = 250 +/- 26
CENTROID : 75.97 = 3.99MeV
SHAPE : Fwhm = 0.03MeV Fwtm = 0.05MeV

ID : No close library match

ROI # 2-2 RANGE : 292 = 4.54MeV to 362 = 4.72MeV
AREA : Gross = 2475 Net = 2298 +/- 65
CENTROID : 342.60 = 4.67MeV
SHAPE : Fwhm = 0.04MeV Fwtm = 0.12MeV

ID : No close library match

ROI # 2-3 RANGE : 579 = 5.27MeV to 664 = 5.49MeV
AREA : Gross = 11132 Net = 9971 +/- 160
CENTROID : 638.54 = 5.43MeV
SHAPE : Fwhm = 0.04MeV Fwtm = 0.14MeV

ID : No close library match

ROI # 2-4 RANGE : 697 = 5.58MeV to 770 = 5.76MeV
AREA : Gross = 11444 Net = 10494 +/- 146
CENTROID : 742.90 = 5.69MeV
SHAPE : Fwhm = 0.06MeV Fwtm = 0.13MeV

ID : No close library match

Procedure: The extraction, separation, and source preparation procedures shown below are used to process samples.

B 454.83 dpm/g
A 4500 dpm/g

~~4300~~ 8000 dpm

Sample ID # NUPI-4T1-PWD
Date 1/9/96

Sequential phase extractions

(I) IE *Readily ion-exchangeable*

1. Weigh 1-3 g powdered sample into a 50 ml PP centrifuge tube.

   Sample weight = 2.6754 g
   Sample weight + tube = 13.4712 g

   Add 50 ml of 1 M $MgCl_2$ at pH 7 and shake for 1 hour on wrist shaker.

2. Centrifuge at 10,000 rpm for 10 min; transfer supernate to PP bottle and label as 'IE' fraction. Add 30 ml ultrapure water to tube; homogenize; centrifuge at 10,000 rpm for 10 min and add supernate to PP bottle.

   Place tube with residue in drying oven overnight.

3. Add $^{232}U/^{228}Th$ spike to supernate and record spike weight.

   Spike # 25B
   Reference Activity 204.88 pCi/g
   Reference Date 1/22/93
   Spike weight 1.8731 g

   Add 0.5 mls Fe carrier and allow to equilibrate overnight.

4. Transfer half of solution into a 50 ml PP centrifuge tube. Add 2 mls conc HCl and mix; add ammonia solution gradually, stirring after each addition until Fe-hydroxide precipitates (red-brown).

   Note: Take care not to add too much ammonia or the Mg will precipitate too, producing a thick white precipitate. If this does happen re-dissolve in HCl and repeat precipitation.

5. Centrifuge and discard supernate. Wash with 0.05 M ammonia, centrifuge and discard washings. Precipitate is now ready for U/Th ion exchange separation.

(II). Ad *Adsorbed*

1. Cool and record weight of dried residue in tube.

   Weight = 13.4342 g

2. Add 30 ml of Morgan's reagent and 0.03 ml 0.02 M EDTA to the residue in the tube. Shake for at least 6 hrs on wrist shaker.

3. Centifuge at 10,000 rpm for 10 min. Transfer supernate to PP bottle and label as 'AD' fraction. Add 30 mls ultrapure water, homogenize, centrifuge at 10,000 rpm for 10 min, and add supernate to PP bottle.

   Place tube with residue in drying oven overnight.

4. Add $^{232}U/^{228}Th$ spike to supernate and record spike weight.

   Spike # 25B
   Reference Activity 204.88 pCi/g
   Reference Date 1/22/93
   Spike weight 1.9166 g

   Add 0.5 ml Fe carrier to supernate and allow to equilibrate overnight.

5. Transfer half of solution into a large teflon beaker. Evaporate to dryness under an infrared lamp.

6. Add 20 ml of conc HNO_3 and then add 20 mls perchloric acid. Reflux gently on a hotplate until the solution has turned pale straw to water-white in color.

7. Evaporate to dryness under an infrared lamp.

8. Dissolve in 50 mls 8 M HCl and 50 mls DI water, warm on hotplate if necessary. Allow to cool.

9. Co-precipitate the U, Th, and Fe with conc ammonia added dropwise. Transfer solution to 50 ml PP centrifuge tubes, centrifuge and discard supernate. Wash with 0.05 M ammonia, centrifuge and discard washings. Precipitate is now ready for U/Th ion exchange separation.

(III) AM *Amorphous iron oxides*

1. Cool and record weight of dried residue in tube.

   Weight = 13.4188 g

2. Add 50 ml of Tamm's acid oxalate reagent to the residue in the tube. Shake for 4 hrs on wrist shaker in the dark. Check after the 1st hour and carefully release any built up pressure.

3. Centifuge quickly at 10,000 rpm for 10 min; minimize exposure to light. Transfer supernate to PP bottle and label as 'AM' fraction. Add a further 30 mls oxalate solution to the residue and shake for a further half hour.

4. Centrifuge at 10,000 rpm for 10 min, and add supernate to PP bottle. Add 30 mls ultrapure water to residue, homogenize, centrifuge, and add supernate to PP bottle.

   Place tube with residue in drying oven overnight.

5. Add $^{232}U/^{228}Th$ spike to supernate and record spike weight.

   Spike # 25A
   Reference Activity 2.051 μCi/g
   Reference Date 1/22/93
   Spike weight .9577 g

   Allow to equilibrate overnight.

6. Transfer half of solution into a large teflon beaker. Evaporate to dryness under an infrared lamp.

7. Add 20 ml of conc HNO_3 and then add 20 mls perchloric acid. Reflux gently on a hotplate until the solution has turned pale straw to water-white in color.

8. Evaporate to dryness under an infrared lamp.

9. Dissolve in 50 mls 8 M HCl and 50 mls DI water, warm on hotplate if necessary. Allow to cool.

10. Co-precipitate the U, Th, and Fe with conc ammonia added dropwise. Transfer solution to 50 ml PP centrifuge tubes, centrifuge and discard supernate. Wash with 0.05 M ammonia, centrifuge and discard washings. Precipitate is now ready for U/Th ion exchange separation.

(IV) CR *Crystalline iron oxides*

1. Cool and record weight of dried residue in tube.

   Weight = 13.3139 g

2. Add 30 ml of Coffin's reagent to the residue in the tube. Add 1.5 g (5%) of sodium dithionite ($Na_2S_2O_4$) and shake for 1 hr on wrist shaker.

3. Centifuge at10,000 rpm for 10 min. Transfer supernate to PP bottle and label as 'CR' fraction.

4. Re-extract with fresh solution if residue is not completely free of Fe (residue should be white or gray). Centrifuge at 10,000 rpm for 10 min, and add supernate to PP bottle. Add 30 mls ultrapure water to residue, homogenize, centrifuge, and add supernate to PP bottle.

   Place tube with residue in drying oven overnight.

5. Add $^{232}U/^{228}Th$ spike to supernate and record spike weight.

   Spike # 25A
   Reference Activity 7.051 pCi/g
   Reference Date 1/22/93
   Spike weight 1.1739 g

   Allow to equilibrate overnight.

6. Transfer half of solution into a large teflon beaker. Evaporate to dryness under an infrared lamp. (A crystalline crust will form and it may be necessary to break it up with a stirring rod to assist drying-out.)

7. Add conc nitric acid drop-by-drop until effervescence ceases. (Be careful, reaction can be quite violent.)

8. Evaporate to dryness under an infrared lamp.

9. Add 20 ml of conc HNO_3 and then add 20 mls perchloric acid. Reflux gently on a hotplate until the solution has turned pale straw to water-white in color.

10. Evaporate to dryness under an infrared lamp.

11. Repeat steps 9-10.

12. Dissolve in 50 mls 8 M HCl and 50 mls DI water, warm on hotplate if necessary. Allow to cool.

13. Co-precipitate the U, Th, and Fe with conc ammonia added dropwise. Transfer solution to 50 ml PP centrifuge tubes, centrifuge and discard supernate. Wash with 0.05 M ammonia, centrifuge and discard washings. Precipitate is now ready for U/Th ion exchange separation.

(V) R *Resistate (primary minerals and clays)*

1. Cool and record weight of dried residue in tube.

   Weight = 11.5523 g

2. Transfer residue to a teflon PFA vessel for microwave digestion.

3. Using a weighing boat, quantitatively add a known amount of $^{232}U/^{228}Th$ spike to the PFA vessel.

   $^{232}U/^{228}Th$ spike # 25B   Reference Date 1/22/93

   Reference Activity 204.88 pCi/g   Spike wt. 1.9119 g

3. Add reagents to vessel and record volumes:

Reagents	Volume (ml)

4. Seal vessel, place on turntable in microwave, enter and run digestion program. Cool and vent vessel. If sample is not completely dissolved repeat step 4 .

5. Quantitatively transfer sample to a clean teflon beaker, washing the PFA vessel several times with ultrapure water.

6. Split sample into two parts: half is saved in a PP bottle for later processing if necessary and the other half is analyzed for U and Th isotopes.

7. Add 1 ml of perchloric acid ($HCLO_4$) to the sample solution in the teflon beaker. Evaporate to fumes of $HCLO_4$. Pick up in a small amount (~2 ml) of conc. HCl and dilute to approximately 2M (total ~10 ml).

8. Transfer solution to a 50 ml PP centrifuge tube. Add 0.5 ml Fe carrier and coprecipitate actinides by addition of NH_4OH to pH = 7.
   **Note: if sample already contains significant Fe, then Fe carrier does not need to be added.

9. Separate the Fe scavange by centrifugation and decant. Wash the precipitate with ultrapure water, centrifuge, and decant. Repeat washing. Precipitate is ready for ion-exchange separation.

Ion Exchange Separation - all precipitates

Dissovle the precipitates in ~3 ml conc HCl. Add 1 ml ultrapure water to dilute to ~9M.

Main Column (Biorad 1.5 cm diameter column with 10 cm resin; prewash with 4-5 column vols 9M HCl)

- Load sample in 9M HCl and allow to drain ✓
- Wash 3 volumes (~35 ml) 9M HCl --> Th ✓ ✓ ✓
- Elute 4 volumes (~50 ml) 0.1M HCl --> U and Fe ___ ___ ___ ___

Separation Date 1/25/96

***Note: May work on U and Th fractions simultaneously from this point on.

Thorium Column (Biorad 0.7 cm diameter column with 10 cm resin; prewash with 4-5 column vols 8M HNO_3)

- Heat Th fraction to evaporate HCl ___
- Add ~5 ml conc HNO_3 to dissolve residue ___
- Add equal vol (~5 ml) DI water so soln 8M HNO_3 ___
- Load onto column in 8M HNO_3 ___
- Wash 3-4 column vols 8M HNO_3 ___ ___ ___
- Elute 4-5 column vols 9M HCl --> Th ___ ___ ___ ___

Uranium Column (Biorad 0.7 cm diameter column with 10 cm resin; prewash with 4-5 column vols 8M HNO_3)

- Evaoprate U fraction to near dryness ___
- Pick up in about 2 ml conc HNO_3 ___
- Dilute with about 2 ml DI water to approx 8M HNO_3 ___
- Load onto column in 8M HNO_3 ___
- Wash 2 vols (8-10 ml) 8M HNO_3 --> Fe ___ ___
- Elute 4-5 vols 0.1M HCl --> U ___ ___ ___ ___

Source Preparation:

Thorium - OH^- precipitation onto filter

1. Evaporate solution containing Th to near dryness.
2. Add 6 ml 0.05 M EDTA soln to dissolve residue, transfer soln to a 50 ml PP centrifuge tube and place tube in boiling water for a few minutes.
3. Add 100 µl purified cerous nitrate (0.5 mg/ml Ce) to precipitate hydroxides. Mix, add 2 drops 25% hydrazine dihydrochloride, and 2 ml of 10M NaOH.
4. Place tube in boiling water bath for 10 minutes, remove, and place tube in cold water for 10 minutes to ensure complete precipitation
5. Wet a 25 mm membrane filter with 80% ethanol and place in a 50 ml polysulfone filter funnel.
6. Shake bottle of substrate suspension (ceric hydroxide containing 10 µg Ce/ml) vigorously and draw 2 consecutive 5 ml portions through the filter with full suction. Allow each portion to suck dry for 10-15 sec.
7. Without interrupting suction, pour the sample into the filter chimney and allow to suck dry.
8. While the sample is still filtering, add 0.5 ml 10M NaOH to the sample tube and about 5 ml ultrapure water down the sides of the tube. After the sample has sucked dry, swirl the wash solution around the sides and add it to the filter chimney.
9. Wash tube, filter chimney, precipitate, and filter with three consecutive 5 ml portions of 80% ethanol.
10. Suck filter dry for about 15 sec and remove the chimney and filter carefully without interrupting the suction. Transfer filter to a plastic container and at low temperature (~60C).
11. Glue to tape the dry filter onto a 1 inch stainless steel planchet and count.

Th Counting Date 1/29/96

Uranium - F^- precipitation onto filter

1. To the solution containing U, add 1 ml of 10% sodium hydrogen sulfate and 100 µl puriified cerous nitrate (0.5 mg/ml Ce, 50 µg of Ce carrier) and evaporate the solution until completely dry and no more fumes are given off.
2. Add 2 ml of 1M HCl to the beaker containing the purified U fraction and heat gently to dissolve the sodium hydrogen sulfate cake and any possible insoluble double salts with the Ce carrier.
3. Transfer solution to a 50 ml polycarbonate centrifuge tube with two more 2 ml portions of 1M HCl.
4. Add 2 drops of 20% titanium trichloride which should produce a strong violet color. If not, iron is probably present and a few more drops of titanium trichloride must be added to produce a permanent violet color or reduction and precipitation of U will be incomplete.
5. Add 0.5 ml (10 drops) of 48% HF. The violet color dissappears and any slight turbidity should clear up.
6. Mix thoroughly and allow solution to stand for 30 min in a cold water bath to obtain complete precipitation of cerous and uranous fluorides.
7. Place the tube in an ultrasonic bath for 1 min to disperse the precipitate.
8. Mount the precipitate on a 25 mm membrane filter previously treated with two 5 ml portions of cerous fluoride substrate as described above.
9. After sucking the precipitate dry, wash with 5 ml of water containing 2 drops of 48% HF and then with 80% ethanol.
10. Dry and analyze as described above.

U Counting Date 1/29/96

Procedure: The extraction, separation, and source preparation procedures shown below are used to process samples.

Sample ID # NOPI-418-PUD
Date 12/27/95

Sequential phase extractions

(I) IE *Readily ion-exchangeable*

1. Weigh 1-3 g powdered sample into a 50 ml PP centrifuge tube.

   Sample weight = 2.5176 g
   Sample weight + tube = 13.2637 g

   Add 50 ml of 1 M $MgCl_2$ at pH 7 and shake for 1 hour on wrist shaker.

   7000 GP 12/27/95

2. Centrifuge at ~~10,000~~ rpm for 10 min; transfer supernate to PP bottle and label as 'IE' fraction. Add 30 ml ultrapure water to tube; homogenize; centrifuge at ~~10,000~~ 7000 rpm for 10 min and add supernate to PP bottle.

   Place tube with residue in drying oven overnight.

3. Add $^{232}U/^{228}Th$ spike to supernate and record spike weight.

   Spike # 25A
   Reference Activity 2.051 μCi/g
   Reference Date 1/22/93
   Spike weight .5006 g

   Add 0.5 mls Fe carrier and allow to equilibrate overnight.

4. Transfer half of solution into a 50 ml PP centrifuge tube. Add 2 mls conc HCl and mix; add ammonia solution gradually, stirring after each addition until Fe-hydroxide precipiates (red-brown).

   Note: Take care not to add too much ammonia or the Mg will precipitate too, producing a thick white precipitate. If this does happen re-dissolve in HCl and repeat precipitation.

5. Centrifuge and discard supernate. Wash with 0.05 M ammonia, centrifuge and discard washings. Precipitate is now ready for U/Th ion exchange separation.

(II). Ad *Adsorbed*

1. **Cool and record weight of dried residue in tube.**

   Weight = 13.21~~47~~ 76 g

2. Add 30 ml of Morgan's reagent and 0.03 ml 0.02 M EDTA to the residue in the tube. Shake for at least 6 hrs on wrist shaker.

3. Centifuge at ~~10,000~~ 7000 gp 12/28/95 rpm for 10 min. Transfer supernate to PP bottle and label as 'AD' fraction. Add 30 mls ultrapure water, homogenize, centrifuge at ~~10,000~~ 7000 rpm for 10 min, and add supernate to PP bottle.

   Place tube with residue in drying oven overnight.

4. Add $^{232}U/^{228}Th$ spike to supernate and record spike weight.

   Spike # 25A Reference Date 1/22/93
   Reference Activity 2.051 nCi/g Spike weight .4971 g

   Add 0.5 ml Fe carrier to supernate and allow to equilibrate overnight.

5. Transfer half of solution into a large teflon beaker. Evaporate to dryness under an infrared lamp.

6. Add 20 ml of conc HNO_3 and then add 20 mls perchloric acid. Reflux gently on a hotplate until the solution has turned pale straw to water-white in color.

7. Evaporate to dryness under an infrared lamp.

8. Dissolve in 50 mls 8 M HCl and 50 mls DI water, warm on hotplate if necessary. Allow to cool.

9. Co-precipitate the U, Th, and Fe with conc ammonia added dropwise. Transfer solution to 50 ml PP centrifuge tubes, centrifuge and discard supernate. Wash with 0.05 M ammonia, centrifuge and discard washings. Precipitate is now ready for U/Th ion exchange separation.

(III) AM *Amorphous iron oxides*

1. Cool and record weight of dried residue in tube.

   Weight = 13.1940 g

2. Add 50 ml of Tamm's acid oxalate reagent to the residue in the tube. Shake for 4 hrs on wrist shaker in the dark. Check after the 1st hour and carefully release any built up pressure.

3. Centifuge quickly at ~~10,000~~ 7000 rpm for 10 min; minimize exposure to light. Transfer supernate to PP bottle and label as 'AM' fraction. Add a further 30 mls oxalate solution to the residue and shake for a further half hour.

4. Centrifuge at ~~10,000~~ 7000 rpm for 10 min, and add supernate to PP bottle. Add 30 mls ultrapure water to residue, homogenize, centrifuge, and add supernate to PP bottle.

   Place tube with residue in drying oven overnight.

5. Add $^{232}U/^{228}Th$ spike to supernate and record spike weight.

   Spike # 25A
   Reference Activity 2.051 μCi/g
   Reference Date 1/22/93
   Spike weight .9646 g

   Allow to equilibrate overnight.

6. Transfer half of solution into a large teflon beaker. Evaporate to dryness under an infrared lamp.

7. Add 20 ml of conc HNO_3 and then add 20 mls perchloric acid. Reflux gently on a hotplate until the solution has turned pale straw to water-white in color.

8. Evaporate to dryness under an infrared lamp.

9. Dissolve in 50 mls 8 M HCl and 50 mls DI water, warm on hotplate if necessary. Allow to cool.

10. Co-precipitate the U, Th, and Fe with conc ammonia added dropwise. Transfer solution to 50 ml PP centrifuge tubes, centrifuge and discard supernate. Wash with 0.05 M ammonia, centrifuge and discard washings. Precipitate is now ready for U/Th ion exchange separation.

(IV) CR *Crystalline iron oxides*

1. Cool and record weight of dried residue in tube.

   Weight = 13.0528 g

2. Add 30 ml of Coffin's reagent to the residue in the tube. Add 1.5 g (5%) of sodium dithionite ($Na_2S_2O_4$) and shake for 1 hr on wrist shaker.

3. Centifuge at ~~10,000~~ 7000 rpm for 10 min. Transfer supernate to PP bottle and label as 'CR' fraction.

4. Re-extract with fresh solution if residue is not completely free of Fe (residue should be white or gray). Centrifuge at ~~10,000~~ 7000 rpm for 10 min, and add supernate to PP bottle. Add 30 mls ultrapure water to residue, homogenize, centrifuge, and add supernate to PP bottle.

   Place tube with residue in drying oven overnight.

5. Add $^{232}U/^{228}Th$ spike to supernate and record spike weight.

   Spike # 25A
   Reference Activity 2.051 nCi/g
   Reference Date 1/22/93
   Spike weight 2.3590 g

   Allow to equilibrate overnight.

6. Transfer half of solution into a large teflon beaker. Evaporate to dryness under an infrared lamp. (A crystalline crust will form and it may be necessary to break it up with a stirring rod to assist drying-out.)

7. Add conc nitric acid drop-by-drop until effervescence ceases. (Be careful, reaction can be quite violent.)

8. Evaporate to dryness under an infrared lamp.

9. Add 20 ml of conc HNO_3 and then add 20 mls perchloric acid. Reflux gently on a hotplate until the solution has turned pale straw to water-white in color.

10. Evaporate to dryness under an infrared lamp.

11. Repeat steps 9-10.

12. Dissolve in 50 mls 8 M HCl and 50 mls DI water, warm on hotplate if necessary. Allow to cool.

13. Co-precipitate the U, Th, and Fe with conc ammonia added dropwise. Transfer solution to 50 ml PP centrifuge tubes, centrifuge and discard supernate. Wash with 0.05 M ammonia, centrifuge and discard washings. Precipitate is now ready for U/Th ion exchange separation.

(V) R *Resistate (primary minerals and clays)*

1. Cool and record weight of dried residue in tube.

   Weight = 10.5524 g

2. Transfer residue to a teflon PFA vessel for microwave digestion.

3. Using a weighing boat, quantitatively add a known amount of $^{232}U/^{228}Th$ spike to the PFA vessel.

   $^{232}U/^{228}Th$ spike # 25A Reference Date 1/22/93

   Reference Activity 2.051 pCi/g Spike wt. .4999 g

3. Add reagents to vessel and record volumes:

Reagents	Volume (ml)
HF	15
HNO_3	3

4. Seal vessel, place on turntable in microwave, enter and run digestion program. Cool and vent vessel. If sample is not completely dissolved repeat step 4 .

5. Quantitatively transfer sample to a clean teflon beaker, washing the PFA vessel several times with ultrapure water.

6. Split sample into two parts: half is saved in a PP bottle for later processing if necessary and the other half is analyzed for U and Th isotopes.

7. Add 1 ml of perchloric acid ($HCLO_4$) to the sample solution in the teflon beaker. Evaporate to fumes of $HCLO_4$. Pick up in a small amount (~2 ml) of conc. HCl and dilute to approximately 2M (total ~10 ml).

8. Transfer solution to a 50 ml PP centrifuge tube. Add 0.5 ml Fe carrier and coprecipitate actinides by addition of NH_4OH to pH = 7.
   **Note: if sample already contains significant Fe, then Fe carrier does not need to be added.

9. Separate the Fe scavange by centrifugation and decant. Wash the precipitate with ultrapure water, centrifuge, and decant. Repeat washing. Precipitate is ready for ion-exchange separation.

Ion Exchange Separation - all precipitates

Dissovle the precipitates in ~3 ml conc HCl. Add 1 ml ultrapure water to dilute to ~9M.

Main Column (Biorad 1.5 cm diameter column with 10 cm resin; prewash with 4-5 column vols 9M HCl)

- Load sample in 9M HCl and allow to drain ✓
- Wash 3 volumes (~35 ml) 9M HCl --> Th ✓ ✓ ✓
- Elute 4 volumes (~50 ml) 0.1M HCl --> U and Fe ✓ ✓ ✓ ✓

Separation Date 1/10/96
Except CR 1/12/96

***Note: May work on U and Th fractions simultaneously from this point on.

AD 1/25/96 rerun
AM 2/5/96 rerun
CR 2/12/96 rerun

Thorium Column (Biorad 0.7 cm diameter column with 10 cm resin; prewash with 4-5 column vols 8M HNO_3)

- Heat Th fraction to evaporate HCl ✓
- Add ~5 ml conc HNO_3 to dissolve residue ✓
- Add equal vol (~5 ml) DI water so soln 8M HNO_3 ✓
- Load onto column in 8M HNO_3 ✓
- Wash 3-4 column vols 8M HNO_3 ✓ ✓ ✓
- Elute 4-5 column vols 9M HCl --> Th ✓ ✓ ✓ ✓

Uranium Column (Biorad 0.7 cm diameter column with 10 cm resin; prewash with 4-5 column vols 8M HNO_3)

- Evaoprate U fraction to near dryness ✓
- Pick up in about 2 ml conc HNO_3 ✓
- Dilute with about 2 ml DI water to approx 8M HNO_3 ✓
- Load onto column in 8M HNO_3 ✓
- Wash 2 vols (8-10 ml) 8M HNO_3 --> Fe ✓ ✓
- Elute 4-5 vols 0.1M HCl --> U ✓ ✓ ✓ ✓

Source Preparation:

Thorium - OH^- precipitation onto filter

1. Evaporate solution containing Th to near dryness.
2. Add 6 ml 0.05 M EDTA soln to dissolve residue, transfer soln to a 50 ml PP centrifuge tube and place tube in boiling water for a few minutes.
3. Add 100 µl purified cerous nitrate (0.5 mg/ml Ce) to precipitate hydroxides. Mix, add 2 drops 25% hydrazine dihydrochloride, and 2 ml of 10M NaOH.
4. Place tube in boiling water bath for 10 minutes, remove, and place tube in cold water for 10 minutes to ensure complete precipitation
5. Wet a 25 mm membrane filter with 80% ethanol and place in a 50 ml polysulfone filter funnel.
6. Shake bottle of substrate suspension (ceric hydroxide containing 10 µg Ce/ml) vigorously and draw 2 consecutive 5 ml portions through the filter with full suction. Allow each portion to suck dry for 10-15 sec.
7. Without interrupting suction, pour the sample into the filter chimney and allow to suck dry.
8. While the sample is still filtering, add 0.5 ml 10M NaOH to the sample tube and about 5 ml ultrapure water down the sides of the tube. After the sample has sucked dry, swirl the wash solution around the sides and add it to the filter chimney.
9. Wash tube, filter chimney, precipitate, and filter with three consecutive 5 ml portions of 80% ethanol.
10. Suck filter dry for about 15 sec and remove the chimney and filter carefully without interrupting the suction. Transfer filter to a plastic container and at low temperature (~60C).
11. Glue to tape the dry filter onto a 1 inch stainless steel planchet and count.

Th Counting Date 1/17/96

AD - 1/29/96
AM - 2/7/96
CR - 2/14/96

Uranium - F^- precipitation onto filter

1. To the solution containing U, add 1 ml of 10% sodium hydrogen sulfate and 100 µl puriified cerous nitrate (0.5 mg/ml Ce, 50 µg of Ce carrier) and evaporate the solution until completely dry and no more fumes are given off.
2. Add 2 ml of 1M HCl to the beaker containing the purified U fraction and heat gently to dissolve the sodium hydrogen sulfate cake and any possible insoluble double salts with the Ce carrier.
3. Transfer solution to a 50 ml polycarbonate centrifuge tube with two more 2 ml portions of 1M HCl.
4. Add 2 drops of 20% titanium trichloride which should produce a strong violet color. If not, iron is probably present and a few more drops of titanium trichloride must be added to produce a permanent violet color or reduction and precipitation of U will be incomplete.
5. Add 0.5 ml (10 drops) of 48% HF. The violet color dissappears and any slight turbidity should clear up.
6. Mix thoroughly and allow solution to stand for 30 min in a cold water bath to obtain complete precipitation of cerous and uranous fluorides.
7. Place the tube in an ultrasonic bath for 1 min to disperse the precipitate.
8. Mount the precipitate on a 25 mm membrane filter previously treated with two 5 ml portions of cerous fluoride substrate as described above.
9. After sucking the precipitate dry, wash with 5 ml of water containing 2 drops of 48% HF and then with 80% ethanol.
10. Dry and analyze as described above.

U Counting Date 1/17/96

AD 1/29/96
AM 2/7/96
CR 2/14/96

Procedure: The extraction, separation, and source preparation procedures shown below are used to process samples.

Sample ID # NOPI-418-PWD
Date 5/9/96

Sequential phase extractions

(I) IE *Readily ion-exchangeable*

1. Weigh 1-3 g powdered sample into a 50 ml PP centrifuge tube.

   Sample weight = 2.5066 g
   Sample weight + tube = 12.8429 g

   Add 50 ml of 1 M $MgCl_2$ at pH 7 and shake for 1 hour on wrist shaker.

2. Centrifuge at 10,000 rpm for 10 min; transfer supernate to PP bottle and label as 'IE' fraction. Add 30 ml ultrapure water to tube; homogenize; centrifuge at 10,000 rpm for 10 min and add supernate to PP bottle.

   Place tube with residue in drying oven overnight.

3. Add $^{232}U/^{228}Th$ spike to supernate and record spike weight.

   Spike # 258
   Reference Activity 204.82 pCi/g
   Reference Date 1/22/93
   Spike weight 1.0046 g

   Add 0.5 mls Fe carrier and allow to equilibrate overnight.

4. Transfer half of solution into a 50 ml PP centrifuge tube. Add 2 mls conc HCl and mix; add ammonia solution gradually, stirring after each addition until Fe-hydroxide precipitates (red-brown).

   Note: Take care not to add too much ammonia or the Mg will precipitate too, producing a thick white precipitate. If this does happen re-dissolve in HCl and repeat precipitation.

5. Centrifuge and discard supernate. Wash with 0.05 M ammonia, centrifuge and discard washings. Precipitate is now ready for U/Th ion exchange separation.

(II). Ad *Adsorbed*

1. Cool and record weight of dried residue in tube.

   Weight = ~~12.7983~~ 12.8135 g

2. Add 30 ml of Morgan's reagent and 2.0 ml 0.3 M EDTA to the residue in the tube. Shake for at least 6 hrs on wrist shaker.

3. Centifuge at 10,000 rpm for 10 min. Transfer supernate to PP bottle and label as 'AD' fraction. Add 30 mls ultrapure water, homogenize, centrifuge at 10,000 rpm for 10 min, and add supernate to PP bottle.

   Place tube with residue in drying oven overnight.

4. Add $^{232}U/^{228}Th$ spike to supernate and record spike weight.

   Spike # 25A
   Reference Activity 2.051 Ci/g
   Reference Date 1/22/93
   Spike weight 0.8467 g

   Add 0.5 ml Fe carrier to supernate and allow to equilibrate overnight.

5. Transfer half of solution into a large teflon beaker. Evaporate to dryness under an infrared lamp.

6. Add 20 ml of conc HNO_3 and then add 20 mls perchloric acid. Reflux gently on a hotplate until the solution has turned pale straw to water-white in color.

7. Evaporate to dryness under an infrared lamp.

8. Dissolve in 50 mls 8 M HCl and 50 mls DI water, warm on hotplate if necessary. Allow to cool.

9. Co-precipitate the U, Th, and Fe with conc ammonia added dropwise. Transfer solution to 50 ml PP centrifuge tubes, centrifuge and discard supernate. Wash with 0.05 M ammonia, centrifuge and discard washings. Precipitate is now ready for U/Th ion exchange separation.

$$\begin{array}{r} 82 \\ 8 \\ \hline 656 \end{array} \qquad \begin{array}{r} 1000 \\ 656 \\ \hline 344 \end{array}$$

(III) AM *Amorphous iron oxides*

1. Cool and record weight of dried residue in tube.

   Weight = 12.7740 g

2. Add 50 ml of Tamm's acid oxalate reagent to the residue in the tube. Shake for 4 hrs on wrist shaker in the dark. Check after the 1st hour and carefully release any built up pressure.

3. Centifuge quickly at 10,000 rpm for 10 min; minimize exposure to light. Transfer supernate to PP bottle and label as 'AM' fraction. Add a further 30 mls oxalate solution to the residue and shake for a further half hour.

4. Centrifuge at 10,000 rpm for 10 min, and add supernate to PP bottle. Add 30 mls ultrapure water to residue, homogenize, centrifuge, and add supernate to PP bottle.

   Place tube with residue in drying oven overnight.

5. Add $^{232}U/^{228}Th$ spike to supernate and record spike weight.

   Spike # 25A
   Reference Activity 2.051 n ~~p~~Ci/g
   Reference Date 1/22/93
   Spike weight 1.0001 g

   Allow to equilibrate overnight.

6. Transfer half of solution into a large teflon beaker. Evaporate to dryness under an infrared lamp.

7. Add 20 ml of conc HNO_3 and then add 20 mls perchloric acid. Reflux gently on a hotplate until the solution has turned pale straw to water-white in color.

8. Evaporate to dryness under an infrared lamp.

9. Dissolve in 50 mls 8 M HCl and 50 mls DI water, warm on hotplate if necessary. Allow to cool.

10. Co-precipitate the U, Th, and Fe with conc ammonia added dropwise. Transfer solution to 50 ml PP centrifuge tubes, centrifuge and discard supernate. Wash with 0.05 M ammonia, centrifuge and discard washings. Precipitate is now ready for U/Th ion exchange separation.

(IV) CR *Crystalline iron oxides*

1. Cool and record weight of dried residue in tube.

   Weight = 12.6231 g

2. Add 30 ml of Coffin's reagent to the residue in the tube. Add 1.5 g (5%) of sodium dithionite ($Na_2S_2O_4$) and shake for 1 hr on wrist shaker.

3. Centifuge at10,000 rpm for 10 min. Transfer supernate to PP bottle and label as 'CR' fraction.

4. Re-extract with fresh solution if residue is not completely free of Fe (residue should be white or gray). Centrifuge at 10,000 rpm for 10 min, and add supernate to PP bottle. Add 30 mls ultrapure water to residue, homogenize, centrifuge, and add supernate to PP bottle.

   Place tube with residue in drying oven overnight.

5. Add $^{232}U/^{228}Th$ spike to supernate and record spike weight.

   Spike # 25A
   Reference Activity 2.051 µCi/g
   Reference Date 1/22/93
   Spike weight .9708 g

   Allow to equilibrate overnight.

6. Transfer half of solution into a large teflon beaker. Evaporate to dryness under an infrared lamp. (A crystalline crust will form and it may be necessary to break it up with a stirring rod to assist drying-out.)

7. Add conc nitric acid drop-by-drop until effervescence ceases. (Be careful, reaction can be quite violent.)

8. Evaporate to dryness under an infrared lamp.

9. Add 20 ml of conc HNO_3 and then add 20 mls perchloric acid. Reflux gently on a hotplate until the solution has turned pale straw to water-white in color.

10. Evaporate to dryness under an infrared lamp.

11. Repeat steps 9-10.

12. Dissolve in 50 mls 8 M HCl and 50 mls DI water, warm on hotplate if necessary. Allow to cool.

13. Co-precipitate the U, Th, and Fe with conc ammonia added dropwise. Transfer solution to 50 ml PP centrifuge tubes, centrifuge and discard supernate. Wash with 0.05 M ammonia, centrifuge and discard washings. Precipitate is now ready for U/Th ion exchange separation.

(V) R *Resistate (primary minerals and clays)*

1. Cool and record weight of dried residue in tube.

   Weight = 10.4424 g

2. Transfer residue to a teflon PFA vessel for microwave digestion.

3. Using a weighing boat, quantitatively add a known amount of $^{232}U/^{228}Th$ spike to the PFA vessel.

   $^{232}U/^{228}Th$ spike # 25B   Reference Date 1/22/93

   Reference Activity 204.81 pCi/g   Spike wt. 1.0129 g

3. Add reagents to vessel and record volumes:

Reagents	Volume (ml)
HF	15
HNO_3	3

4. Seal vessel, place on turntable in microwave, enter and run digestion program. Cool and vent vessel. If sample is not completely dissolved repeat step 4 .

5. Quantitatively transfer sample to a clean teflon beaker, washing the PFA vessel several times with ultrapure water.

6. Split sample into two parts: half is saved in a PP bottle for later processing if necessary and the other half is analyzed for U and Th isotopes.

7. Add 1 ml of perchloric acid ($HClO_4$) to the sample solution in the teflon beaker. Evaporate to fumes of $HClO_4$. Pick up in a small amount (~2 ml) of conc. HCl and dilute to approximately 2M (total ~10 ml).

8. Transfer solution to a 50 ml PP centrifuge tube. Add 0.5 ml Fe carrier and coprecipitate actinides by addition of NH_4OH to pH = 7.
   **Note: if sample already contains significant Fe, then Fe carrier does not need to be added.

9. Separate the Fe scavange by centrifugation and decant. Wash the precipitate with ultrapure water, centrifuge, and decant. Repeat washing. Precipitate is ready for ion-exchange separation.

Ion Exchange Separation - all precipitates

Dissovle the precipitates in ~3 ml conc HCl. Add 1 ml ultrapure water to dilute to ~9M.

Main Column (Biorad 1.5 cm diameter column with 10 cm resin; prewash with 4-5 column vols 9M HCl)

Load sample in 9M HCl and allow to drain	✓			
Wash 3 volumes (~35 ml) 9M HCl --> Th	✓	✓	✓	
Elute 4 volumes (~50 ml) 0.1M HCl --> U and Fe	✓	✓	✓	✓

Separation Date 5/21/96 IE RES

***Note: May work on U and Th fractions simultaneously from this point on.

5/27/96 AD AM

6/19/96 CR

Thorium Column (Biorad 0.7 cm diameter column with 10 cm resin; prewash with 4-5 column vols 8M HNO_3)

Heat Th fraction to evaporate HCl	✓			
Add ~5 ml conc HNO_3 to dissolve residue	✓			
Add equal vol (~5 ml) DI water so soln 8M HNO_3	✓			
Load onto column in 8M HNO_3	✓			
Wash 3-4 column vols 8M HNO_3	✓	✓	✓	
Elute 4-5 column vols 9M HCl --> Th	✓	✓	___	___

Uranium Column (Biorad 0.7 cm diameter column with 10 cm resin; prewash with 4-5 column vols 8M HNO_3)

Evaoprate U fraction to near dryness	✓			
Pick up in about 2 ml conc HNO_3	✓			
Dilute with about 2 ml DI water to approx 8M HNO_3	✓			
Load onto column in 8M HNO_3	✓			
Wash 2 vols (8-10 ml) 8M HNO_3 --> Fe	✓	✓		
Elute 4-5 vols 0.1M HCl --> U	✓	✓	✓	✓

$$\begin{array}{r} 82 \\ \times\ 9 \\ \hline 748 \end{array} \qquad \begin{array}{r} 63 \\ \times\ 8 \\ \hline 504 \end{array}$$

Source Preparation:

Thorium - OH^- precipitation onto filter

1. Evaporate solution containing Th to near dryness.
2. Add 6 ml 0.05 M EDTA soln to dissolve residue, transfer soln to a 50 ml PP centrifuge tube and place tube in boiling water for a few minutes.
3. Add 100 µl purified cerous nitrate (0.5 mg/ml Ce) to precipitate hydroxides. Mix, add 2 drops 25% hydrazine dihydrochloride, and 2 ml of 10M NaOH.
4. Place tube in boiling water bath for 10 minutes, remove, and place tube in cold water for 10 minutes to ensure complete precipitation
5. Wet a 25 mm membrane filter with 80% ethanol and place in a 50 ml polysulfone filter funnel.
6. Shake bottle of substrate suspension (ceric hydroxide containing 10 µg Ce/ml) vigorously and draw 2 consecutive 5 ml portions through the filter with full suction. Allow each portion to suck dry for 10-15 sec.
7. Without interrupting suction, pour the sample into the filter chimney and allow to suck dry.
8. While the sample is still filtering, add 0.5 ml 10M NaOH to the sample tube and about 5 ml ultrapure water down the sides of the tube. After the sample has sucked dry, swirl the wash solution around the sides and add it to the filter chimney.
9. Wash tube, filter chimney, precipitate, and filter with three consecutive 5 ml portions of 80% ethanol.
10. Suck filter dry for about 15 sec and remove the chimney and filter carefully without interrupting the suction. Transfer filter to a plastic container and at low temperature (~60C).
11. Glue to tape the dry filter onto a 1 inch stainless steel planchet and count.

Th Counting Date 7/16/96 IE
7/17/96 AD, AM, CR, RES

Uranium - F^- precipitation onto filter

1. To the solution containing U, add 1 ml of 10% sodium hydrogen sulfate and 100 µl puriified cerous nitrate (0.5 mg/ml Ce, 50 µg of Ce carrier) and evaporate the solution until completely dry and no more fumes are given off.
2. Add 2 ml of 1M HCl to the beaker containing the purified U fraction and heat gently to dissolve the sodium hydrogen sulfate cake and any possible insoluble double salts with the Ce carrier.
3. Transfer solution to a 50 ml polycarbonate centrifuge tube with two more 2 ml portions of 1M HCl.
4. Add 2 drops of 20% titanium trichloride which should produce a strong violet color. If not, iron is probably present and a few more drops of titanium trichloride must be added to produce a permanent violet color or reduction and precipitation of U will be incomplete.
5. Add 0.5 ml (10 drops) of 48% HF. The violet color dissappears and any slight turbidity should clear up.
6. Mix thoroughly and allow solution to stand for 30 min in a cold water bath to obtain complete precipitation of cerous and uranous fluorides.
7. Place the tube in an ultrasonic bath for 1 min to disperse the precipitate.
8. Mount the precipitate on a 25 mm membrane filter previously treated with two 5 ml portions of cerous fluoride substrate as described above.
9. After sucking the precipitate dry, wash with 5 ml of water containing 2 drops of 48% HF and then with 80% ethanol.
10. Dry and analyze as described above.

U Counting Date 7/16/96

Procedure: The extraction, separation, and source preparation procedures shown below are used to process samples.

Sample ID # NOPI-420-PWD
Date 1/16/96

Sequential phase extractions

(I) IE *Readily ion-exchangeable*

1. Weigh 1-3 g powdered sample into a 50 ml PP centrifuge tube.

   Sample weight = 2.5294 g
   Sample weight + tube = 12.8869 g

   Add 50 ml of 1 M $MgCl_2$ at pH 7 and shake for 1 hour on wrist shaker.

2. Centrifuge at 10,000 rpm for 10 min; transfer supernate to PP bottle and label as 'IE' fraction. Add 30 ml ultrapure water to tube; homogenize; centrifuge at 10,000 rpm for 10 min and add supernate to PP bottle.

   Place tube with residue in drying oven overnight.

3. Add $^{232}U/^{228}Th$ spike to supernate and record spike weight.

   Spike # 25B
   Reference Activity 204.88 pCi/g
   Reference Date 1/22/93
   Spike weight 1.9157 g

   Add 0.5 mls Fe carrier and allow to equilibrate overnight.

4. Transfer half of solution into a 50 ml PP centrifuge tube. Add 2 mls conc HCl and mix; add ammonia solution gradually, stirring after each addition until Fe-hydroxide precipitates (red-brown).

   Note: Take care not to add too much ammonia or the Mg will precipitate too, producing a thick white precipitate. If this does happen re-dissolve in HCl and repeat precipitation.

5. Centrifuge and discard supernate. Wash with 0.05 M ammonia, centrifuge and discard washings. Precipitate is now ready for U/Th ion exchange separation.

(II). Ad *Adsorbed*

1. Cool and record weight of dried residue in tube.

   Weight = 12.8748 g

2. Add 30 ml of Morgan's reagent and 0.03 ml 0.02 M EDTA to the residue in the tube. Shake for at least 6 hrs on wrist shaker.

3. Centifuge at 10,000 rpm for 10 min. Transfer supernate to PP bottle and label as 'AD' fraction. Add 30 mls ultrapure water, homogenize, centrifuge at 10,000 rpm for 10 min, and add supernate to PP bottle.

   Place tube with residue in drying oven overnight.

4. Add $^{232}U/^{228}Th$ spike to supernate and record spike weight.

   Spike # 253 Reference Date 1/22/93
   Reference Activity 204.88 pCi/g Spike weight 1.9980 g

   Add 0.5 ml Fe carrier to supernate and allow to equilibrate overnight.

5. Transfer half of solution into a large teflon beaker. Evaporate to dryness under an infrared lamp.

6. Add 20 ml of conc HNO_3 and then add 20 mls perchloric acid. Reflux gently on a hotplate until the solution has turned pale straw to water-white in color.

7. Evaporate to dryness under an infrared lamp.

8. Dissolve in 50 mls 8 M HCl and 50 mls DI water, warm on hotplate if necessary. Allow to cool.

9. Co-precipitate the U, Th, and Fe with conc ammonia added dropwise. Transfer solution to 50 ml PP centrifuge tubes, centrifuge and discard supernate. Wash with 0.05 M ammonia, centrifuge and discard washings. Precipitate is now ready for U/Th ion exchange separation.

(III) AM *Amorphous iron oxides*

1. Cool and record weight of dried residue in tube.

   Weight = 12.8447 g

2. Add 50 ml of Tamm's acid oxalate reagent to the residue in the tube. Shake for 4 hrs on wrist shaker in the dark. Check after the 1st hour and carefully release any built up pressure.

3. Centifuge quickly at 10,000 rpm for 10 min; minimize exposure to light. Transfer supernate to PP bottle and label as 'AM' fraction. Add a further 30 mls oxalate solution to the residue and shake for a further half hour.

4. Centrifuge at 10,000 rpm for 10 min, and add supernate to PP bottle. Add 30 mls ultrapure water to residue, homogenize, centrifuge, and add supernate to PP bottle.

   Place tube with residue in drying oven overnight.

5. Add $^{232}U/^{228}Th$ spike to supernate and record spike weight.

   Spike # 25A Reference Date 1/22/93
   Reference Activity 2.051 µCi/g Spike weight 1.0006 g

   Allow to equilibrate overnight.

6. Transfer half of solution into a large teflon beaker. Evaporate to dryness under an infrared lamp.

7. Add 20 ml of conc HNO_3 and then add 20 mls perchloric acid. Reflux gently on a hotplate until the solution has turned pale straw to water-white in color.

8. Evaporate to dryness under an infrared lamp.

9. Dissolve in 50 mls 8 M HCl and 50 mls DI water, warm on hotplate if necessary. Allow to cool.

10. Co-precipitate the U, Th, and Fe with conc ammonia added dropwise. Transfer solution to 50 ml PP centrifuge tubes, centrifuge and discard supernate. Wash with 0.05 M ammonia, centrifuge and discard washings. Precipitate is now ready for U/Th ion exchange separation.

(IV) CR *Crystalline iron oxides*

1. Cool and record weight of dried residue in tube.

   Weight = 12.7964 g

2. Add 30 ml of Coffin's reagent to the residue in the tube. Add 1.5 g (5%) of sodium dithionite ($Na_2S_2O_4$) and shake for 1 hr on wrist shaker.

3. Centifuge at10,000 rpm for 10 min. Transfer supernate to PP bottle and label as 'CR' fraction.

4. Re-extract with fresh solution if residue is not completely free of Fe (residue should be white or gray). Centrifuge at 10,000 rpm for 10 min, and add supernate to PP bottle. Add 30 mls ultrapure water to residue, homogenize, centrifuge, and add supernate to PP bottle.

   Place tube with residue in drying oven overnight.

5. Add $^{232}U/^{228}Th$ spike to supernate and record spike weight.

   Spike # 25A
   Reference Activity 2.051 pCi/g
   Reference Date 1/22/93
   Spike weight 1.5059 g

   Allow to equilibrate overnight.

6. Transfer half of solution into a large teflon beaker. Evaporate to dryness under an infrared lamp. (A crystalline crust will form and it may be necessary to break it up with a stirring rod to assist drying-out.)

7. Add conc nitric acid drop-by-drop until effervescence ceases. (Be careful, reaction can be quite violent.)

8. Evaporate to dryness under an infrared lamp.

9. Add 20 ml of conc HNO_3 and then add 20 mls perchloric acid. Reflux gently on a hotplate until the solution has turned pale straw to water-white in color.

10. Evaporate to dryness under an infrared lamp.

11. Repeat steps 9-10.

12. Dissolve in 50 mls 8 M HCl and 50 mls DI water, warm on hotplate if necessary. Allow to cool.

13. Co-precipitate the U, Th, and Fe with conc ammonia added dropwise. Transfer solution to 50 ml PP centrifuge tubes, centrifuge and discard supernate. Wash with 0.05 M ammonia, centrifuge and discard washings. Precipitate is now ready for U/Th ion exchange separation.

(V) R *Resistate (primary minerals and clays)*

1. Cool and record weight of dried residue in tube.

   Weight = 11.5917 g

2. Transfer residue to a teflon PFA vessel for microwave digestion.

3. Using a weighing boat, quantitatively add a known amount of $^{232}U/^{228}Th$ spike to the PFA vessel.

   $^{232}U/^{228}Th$ spike # 25B   Reference Date 1/22/93

   Reference Activity 204.88 pCi/g   Spike wt. 1.8430 g

3. Add reagents to vessel and record volumes:

Reagents	Volume (ml)

4. Seal vessel, place on turntable in microwave, enter and run digestion program. Cool and vent vessel. If sample is not completely dissolved repeat step 4 .

5. Quantitatively transfer sample to a clean teflon beaker, washing the PFA vessel several times with ultrapure water.

6. Split sample into two parts: half is saved in a PP bottle for later processing if necessary and the other half is analyzed for U and Th isotopes.

7. Add 1 ml of perchloric acid ($HCLO_4$) to the sample solution in the teflon beaker. Evaporate to fumes of $HCLO_4$. Pick up in a small amount (~2 ml) of conc. HCl and dilute to approximately 2M (total ~10 ml).

8. Transfer solution to a 50 ml PP centrifuge tube. Add 0.5 ml Fe carrier and coprecipitate actinides by addition of NH_4OH to pH = 7.
   **Note: if sample already contains significant Fe, then Fe carrier does not need to be added.

9. Separate the Fe scavange by centrifugation and decant. Wash the precipitate with ultrapure water, centrifuge, and decant. Repeat washing. Precipitate is ready for ion-exchange separation.

Ion Exchange Separation - all precipitates

Dissovle the precipitates in ~3 ml conc HCl. Add 1 ml ultrapure water to dilute to ~9M.

Main Column (Biorad 1.5 cm diameter column with 10 cm resin; prewash with 4-5 column vols 9M HCl)

Load sample in 9M HCl and allow to drain
Wash 3 volumes (~35 ml) 9M HCl –> Th
Elute 4 volumes (~50 ml) 0.1M HCl –> U and Fe

Separation Date 2/7/94

***Note: May work on U and Th fractions simultaneously from this point on.

Thorium Column (Biorad 0.7 cm diameter column with 10 cm resin; prewash with 4-5 column vols 8M HNO_3)

Heat Th fraction to evaporate HCl
Add ~5 ml conc HNO_3 to dissolve residue
Add equal vol (~5 ml) DI water so soln 8M HNO_3
Load onto column in 8M HNO_3
Wash 3-4 column vols 8M HNO_3
Elute 4-5 column vols 9M HCl –> Th

Uranium Column (Biorad 0.7 cm diameter column with 10 cm resin; prewash with 4-5 column vols 8M HNO_3)

Evaoprate U fraction to near dryness
Pick up in about 2 ml conc HNO_3
Dilute with about 2 ml DI water to approx 8M HNO_3
Load onto column in 8M HNO_3
Wash 2 vols (8-10 ml) 8M HNO_3 –> Fe
Elute 4-5 vols 0.1M HCl –> U

Source Preparation:

Thorium - OH^- precipitation onto filter

1. Evaporate solution containing Th to near dryness.
2. Add 6 ml 0.05 M EDTA soln to dissolve residue, transfer soln to a 50 ml PP centrifuge tube and place tube in boiling water for a few minutes.
3. Add 100 µl purified cerous nitrate (0.5 mg/ml Ce) to precipitate hydroxides. Mix, add 2 drops 25% hydrazine dihydrochloride, and 2 ml of 10M NaOH.
4. Place tube in boiling water bath for 10 minutes, remove, and place tube in cold water for 10 minutes to ensure complete precipitation
5. Wet a 25 mm membrane filter with 80% ethanol and place in a 50 ml polysulfone filter funnel.
6. Shake bottle of substrate suspension (ceric hydroxide containing 10 µg Ce/ml) vigorously and draw 2 consecutive 5 ml portions through the filter with full suction. Allow each portion to suck dry for 10-15 sec.
7. Without interrupting suction, pour the sample into the filter chimney and allow to suck dry.
8. While the sample is still filtering, add 0.5 ml 10M NaOH to the sample tube and about 5 ml ultrapure water down the sides of the tube. After the sample has sucked dry, swirl the wash solution around the sides and add it to the filter chimney.
9. Wash tube, filter chimney, precipitate, and filter with three consecutive 5 ml portions of 80% ethanol.
10. Suck filter dry for about 15 sec and remove the chimney and filter carefully without interrupting the suction. Transfer filter to a plastic container and at low temperature (~60C).
11. Glue to tape the dry filter onto a 1 inch stainless steel planchet and count.

Th Counting Date 2/9/92

Uranium - F^- precipitation onto filter

1. To the solution containing U, add 1 ml of 10% sodium hydrogen sulfate and 100 µl puriified cerous nitrate (0.5 mg/ml Ce, 50 µg of Ce carrier) and evaporate the solution until completely dry and no more fumes are given off.
2. Add 2 ml of 1M HCl to the beaker containing the purified U fraction and heat gently to dissolve the sodium hydrogen sulfate cake and any possible insoluble double salts with the Ce carrier.
3. Transfer solution to a 50 ml polycarbonate centrifuge tube with two more 2 ml portions of 1M HCl.
4. Add 2 drops of 20% titanium trichloride which should produce a strong violet color. If not, iron is probably present and a few more drops of titanium trichloride must be added to produce a permanent violet color or reduction and precipitation of U will be incomplete.
5. Add 0.5 ml (10 drops) of 48% HF. The violet color dissappears and any slight turbidity should clear up.
6. Mix thoroughly and allow solution to stand for 30 min in a cold water bath to obtain complete precipitation of cerous and uranous fluorides.
7. Place the tube in an ultrasonic bath for 1 min to disperse the precipitate.
8. Mount the precipitate on a 25 mm membrane filter previously treated with two 5 ml portions of cerous fluoride substrate as described above.
9. After sucking the precipitate dry, wash with 5 ml of water containing 2 drops of 48% HF and then with 80% ethanol.
10. Dry and analyze as described above.

U Counting Date 2/9/92

Procedure: The extraction, separation, and source preparation procedures shown below are used to process samples.

6000

~~2512 4000~~

Sample ID # NOPI-421-PWD
Date 1/9/96

Sequential phase extractions

(I) IE *Readily ion-exchangeable*

1. Weigh 1-3 g powdered sample into a 50 ml PP centrifuge tube.

   Sample weight = 2.4309 g
   Sample weight + tube = 12.6853 g

   Add 50 ml of 1 M $MgCl_2$ at pH 7 and shake for 1 hour on wrist shaker.

2. Centrifuge at 10,000 rpm for 10 min; transfer supernate to PP bottle and label as 'IE' fraction. Add 30 ml ultrapure water to tube; homogenize; centrifuge at 10,000 rpm for 10 min and add supernate to PP bottle.

   Place tube with residue in drying oven overnight.

3. Add $^{232}U/^{228}Th$ spike to supernate and record spike weight.

   Spike # 25B
   Reference Activity 204.88 pCi/g
   Reference Date 1/22/93
   Spike weight 1.3716 g

   Add 0.5 mls Fe carrier and allow to equilibrate overnight.

4. Transfer half of solution into a 50 ml PP centrifuge tube. Add 2 mls conc HCl and mix; add ammonia solution gradually, stirring after each addition until Fe-hydroxide precipitates (red-brown).

   Note: Take care not to add too much ammonia or the Mg will precipitate too, producing a thick white precipitate. If this does happen re-dissolve in HCl and repeat precipitation.

5. Centrifuge and discard supernate. Wash with 0.05 M ammonia, centrifuge and discard washings. Precipitate is now ready for U/Th ion exchange separation.

(II). Ad *Adsorbed*

1. Cool and record weight of dried residue in tube.

   Weight = 12.6564 g

2. Add 30 ml of Morgan's reagent and 0.03 ml 0.02 M EDTA to the residue in the tube. Shake for at least 6 hrs on wrist shaker.

3. Centifuge at 10,000 rpm for 10 min. Transfer supernate to PP bottle and label as 'AD' fraction. Add 30 mls ultrapure water, homogenize, centrifuge at 10,000 rpm for 10 min, and add supernate to PP bottle.

   Place tube with residue in drying oven overnight.

4. Add $^{232}U/^{228}Th$ spike to supernate and record spike weight.

   Spike # 25B
   Reference Activity 204.88 pCi/g
   Reference Date 1/22/93
   Spike weight 1.9218 g

   Add 0.5 ml Fe carrier to supernate and allow to equilibrate overnight.

5. Transfer half of solution into a large teflon beaker. Evaporate to dryness under an infrared lamp.

6. Add 20 ml of conc HNO_3 and then add 20 mls perchloric acid. Reflux gently on a hotplate until the solution has turned pale straw to water-white in color.

7. Evaporate to dryness under an infrared lamp.

8. Dissolve in 50 mls 8 M HCl and 50 mls DI water, warm on hotplate if necessary. Allow to cool.

9. Co-precipitate the U, Th, and Fe with conc ammonia added dropwise. Transfer solution to 50 ml PP centrifuge tubes, centrifuge and discard supernate. Wash with 0.05 M ammonia, centrifuge and discard washings. Precipitate is now ready for U/Th ion exchange separation.

(III) AM *Amorphous iron oxides*

1. Cool and record weight of dried residue in tube.

   Weight = 12.6457 g

2. Add 50 ml of Tamm's acid oxalate reagent to the residue in the tube. Shake for 4 hrs on wrist shaker in the dark. Check after the 1st hour and carefully release any built up pressure.

3. Centifuge quickly at 10,000 rpm for 10 min; minimize exposure to light. Transfer supernate to PP bottle and label as 'AM' fraction. Add a further 30 mls oxalate solution to the residue and shake for a further half hour.

4. Centrifuge at 10,000 rpm for 10 min, and add supernate to PP bottle. Add 30 mls ultrapure water to residue, homogenize, centrifuge, and add supernate to PP bottle.

   Place tube with residue in drying oven overnight.

5. Add $^{232}U/^{228}Th$ spike to supernate and record spike weight.

   Spike # 25A
   Reference Activity 2.051 μCi/g
   Reference Date 1/22/93
   Spike weight .9435 g

   Allow to equilibrate overnight.

6. Transfer half of solution into a large teflon beaker. Evaporate to dryness under an infrared lamp.

7. Add 20 ml of conc HNO_3 and then add 20 mls perchloric acid. Reflux gently on a hotplate until the solution has turned pale straw to water-white in color.

8. Evaporate to dryness under an infrared lamp.

9. Dissolve in 50 mls 8 M HCl and 50 mls DI water, warm on hotplate if necessary. Allow to cool.

10. Co-precipitate the U, Th, and Fe with conc ammonia added dropwise. Transfer solution to 50 ml PP centrifuge tubes, centrifuge and discard supernate. Wash with 0.05 M ammonia, centrifuge and discard washings. Precipitate is now ready for U/Th ion exchange separation.

(IV) CR *Crystalline iron oxides*

1. Cool and record weight of dried residue in tube.

   Weight = 12.5498 g

2. Add 30 ml of Coffin's reagent to the residue in the tube. Add 1.5 g (5%) of sodium dithionite ($Na_2S_2O_4$) and shake for 1 hr on wrist shaker.

3. Centifuge at10,000 rpm for 10 min. Transfer supernate to PP bottle and label as 'CR' fraction.

4. Re-extract with fresh solution if residue is not completely free of Fe (residue should be white or gray). Centrifuge at 10,000 rpm for 10 min, and add supernate to PP bottle. Add 30 mls ultrapure water to residue, homogenize, centrifuge, and add supernate to PP bottle.

   Place tube with residue in drying oven overnight.

5. Add $^{232}U/^{228}Th$ spike to supernate and record spike weight.

   Spike # 25A Reference Date 1/22/93
   Reference Activity 2.051 ~~M~~Ci/g Spike weight 1.1321 g

   Allow to equilibrate overnight.

6. Transfer half of solution into a large teflon beaker. Evaporate to dryness under an infrared lamp. (A crystalline crust will form and it may be necessary to break it up with a stirring rod to assist drying-out.)

7. Add conc nitric acid drop-by-drop until effervescence ceases. (Be careful, reaction can be quite violent.)

8. Evaporate to dryness under an infrared lamp.

9. Add 20 ml of conc HNO_3 and then add 20 mls perchloric acid. Reflux gently on a hotplate until the solution has turned pale straw to water-white in color.

10. Evaporate to dryness under an infrared lamp.

11. Repeat steps 9-10.

12. Dissolve in 50 mls 8 M HCl and 50 mls DI water, warm on hotplate if necessary. Allow to cool.

13. Co-precipitate the U, Th, and Fe with conc ammonia added dropwise. Transfer solution to 50 ml PP centrifuge tubes, centrifuge and discard supernate. Wash with 0.05 M ammonia, centrifuge and discard washings. Precipitate is now ready for U/Th ion exchange separation.

(V) R *Resistate (primary minerals and clays)*

1. Cool and record weight of dried residue in tube.

   Weight = 11.2622 g

2. Transfer residue to a teflon PFA vessel for microwave digestion.

3. Using a weighing boat, quantitatively add a known amount of $^{232}U/^{228}Th$ spike to the PFA vessel.

   $^{232}U/^{228}Th$ spike # 25B   Reference Date 1/22/93

   Reference Activity 204.88 pCi/g   Spike wt. 1.8877 g

3. Add reagents to vessel and record volumes:

Reagents	Volume (ml)

4. Seal vessel, place on turntable in microwave, enter and run digestion program. Cool and vent vessel. If sample is not completely dissolved repeat step 4 .

5. Quantitatively transfer sample to a clean teflon beaker, washing the PFA vessel several times with ultrapure water.

6. Split sample into two parts: half is saved in a PP bottle for later processing if necessary and the other half is analyzed for U and Th isotopes.

7. Add 1 ml of perchloric acid ($HClO_4$) to the sample solution in the teflon beaker. Evaporate to fumes of $HClO_4$. Pick up in a small amount (~2 ml) of conc. HCl and dilute to approximately 2M (total ~10 ml).

8. Transfer solution to a 50 ml PP centrifuge tube. Add 0.5 ml Fe carrier and coprecipitate actinides by addition of NH_4OH to pH = 7.
   **Note: if sample already contains significant Fe, then Fe carrier does not need to be added.

9. Separate the Fe scavange by centrifugation and decant. Wash the precipitate with ultrapure water, centrifuge, and decant. Repeat washing. Precipitate is ready for ion-exchange separation.

Ion Exchange Separation - all precipitates

Dissovle the precipitates in ~3 ml conc HCl. Add 1 ml ultrapure water to dilute to ~9M.

Main Column (Biorad 1.5 cm diameter column with 10 cm resin; prewash with 4-5 column vols 9M HCl)

Load sample in 9M HCl and allow to drain	✓			
Wash 3 volumes (~35 ml) 9M HCl --> Th	✓	✓	✓	
Elute 4 volumes (~50 ml) 0.1M HCl --> U and Fe	✓	✓	✓	✓

Separation Date 2/8/96

***Note: May work on U and Th fractions simultaneously from this point on.

Thorium Column (Biorad 0.7 cm diameter column with 10 cm resin; prewash with 4-5 column vols 8M HNO_3)

Heat Th fraction to evaporate HCl	✓			
Add ~5 ml conc HNO_3 to dissolve residue	✓			
Add equal vol (~5 ml) DI water so soln 8M HNO_3	✓			
Load onto column in 8M HNO_3	✓			
Wash 3-4 column vols 8M HNO_3	✓	✓	✓	
Elute 4-5 column vols 9M HCl --> Th	✓	✓	___	___

Uranium Column (Biorad 0.7 cm diameter column with 10 cm resin; prewash with 4-5 column vols 8M HNO_3)

Evaoprate U fraction to near dryness	✓			
Pick up in about 2 ml conc HNO_3	✓			
Dilute with about 2 ml DI water to approx 8M HNO_3	✓			
Load onto column in 8M HNO_3	✓			
Wash 2 vols (8-10 ml) 8M HNO_3 --> Fe	✓	✓		
Elute 4-5 vols 0.1M HCl --> U	✓	✓	✓	✓

Source Preparation:

Thorium - OH^- precipitation onto filter

1. Evaporate solution containing Th to near dryness.
2. Add 6 ml 0.05 M EDTA soln to dissolve residue, transfer soln to a 50 ml PP centrifuge tube and place tube in boiling water for a few minutes.
3. Add 100 µl purified cerous nitrate (0.5 mg/ml Ce) to precipitate hydroxides. Mix, add 2 drops 25% hydrazine dihydrochloride, and 2 ml of 10M NaOH.
4. Place tube in boiling water bath for 10 minutes, remove, and place tube in cold water for 10 minutes to ensure complete precipitation
5. Wet a 25 mm membrane filter with 80% ethanol and place in a 50 ml polysulfone filter funnel.
6. Shake bottle of substrate suspension (ceric hydroxide containing 10 µg Ce/ml) vigorously and draw 2 consecutive 5 ml portions through the filter with full suction. Allow each portion to suck dry for 10-15 sec.
7. Without interrupting suction, pour the sample into the filter chimney and allow to suck dry.
8. While the sample is still filtering, add 0.5 ml 10M NaOH to the sample tube and about 5 ml ultrapure water down the sides of the tube. After the sample has sucked dry, swirl the wash solution around the sides and add it to the filter chimney.
9. Wash tube, filter chimney, precipitate, and filter with three consecutive 5 ml portions of 80% ethanol.
10. Suck filter dry for about 15 sec and remove the chimney and filter carefully without interrupting the suction. Transfer filter to a plastic container and at low temperature (~60C).
11. Glue to tape the dry filter onto a 1 inch stainless steel planchet and count.

Th Counting Date 2/13/96

Uranium - F^- precipitation onto filter

1. To the solution containing U, add 1 ml of 10% sodium hydrogen sulfate and 100 µl puriified cerous nitrate (0.5 mg/ml Ce, 50 µg of Ce carrier) and evaporate the solution until completely dry and no more fumes are given off.
2. Add 2 ml of 1M HCl to the beaker containing the purified U fraction and heat gently to dissolve the sodium hydrogen sulfate cake and any possible insoluble double salts with the Ce carrier.
3. Transfer solution to a 50 ml polycarbonate centrifuge tube with two more 2 ml portions of 1M HCl.
4. Add 2 drops of 20% titanium trichloride which should produce a strong violet color. If not, iron is probably present and a few more drops of titanium trichloride must be added to produce a permanent violet color or reduction and precipitation of U will be incomplete.
5. Add 0.5 ml (10 drops) of 48% HF. The violet color dissappears and any slight turbidity should clear up.
6. Mix thoroughly and allow solution to stand for 30 min in a cold water bath to obtain complete precipitation of cerous and uranous fluorides.
7. Place the tube in an ultrasonic bath for 1 min to disperse the precipitate.
8. Mount the precipitate on a 25 mm membrane filter previously treated with two 5 ml portions of cerous fluoride substrate as described above.
9. After sucking the precipitate dry, wash with 5 ml of water containing 2 drops of 48% HF and then with 80% ethanol.
10. Dry and analyze as described above.

U Counting Date 2/13/96

Procedure: The extraction, separation, and source preparation procedures shown below are used to process samples.

Sample ID # NOPI-423-PWD
Date 12/27/95

Sequential phase extractions

(I) IE *Readily ion-exchangeable*

1. Weigh 1-3 g powdered sample into a 50 ml PP centrifuge tube.

   Sample weight = 2.5369 g
   Sample weight + tube = 12.8541 g

   Add 50 ml of 1 M $MgCl_2$ at pH 7 and shake for 1 hour on wrist shaker.

2. Centrifuge at 10,000 rpm for 10 min; transfer supernate to PP bottle and label as 'IE' fraction. Add 30 ml ultrapure water to tube; homogenize; centrifuge at 10,000 rpm for 10 min and add supernate to PP bottle.

   Place tube with residue in drying oven overnight.

3. Add $^{232}U/^{228}Th$ spike to supernate and record spike weight.

   Spike # 25B
   Reference Activity 204.88 pCi/g
   Reference Date 1/22/93
   Spike weight .5064 g

   Add 0.5 mls Fe carrier and allow to equilibrate overnight.

4. Transfer half of solution into a 50 ml PP centrifuge tube. Add 2 mls conc HCl and mix; add ammonia solution gradually, stirring after each addition until Fe-hydroxide precipiates (red-brown).

   Note: Take care not to add too much ammonia or the Mg will precipitate too, producing a thick white precipitate. If this does happen re-dissolve in HCl and repeat precipitation.

5. Centrifuge and discard supernate. Wash with 0.05 M ammonia, centrifuge and discard washings. Precipitate is now ready for U/Th ion exchange separation.

(II). Ad *Adsorbed*

1. Cool and record weight of dried residue in tube.

   Weight = 12.8439 g

2. Add 30 ml of Morgan's reagent and 0.03 ml 0.02 M EDTA to the residue in the tube. Shake for at least 6 hrs on wrist shaker.

3. Centifuge at 10,000 rpm for 10 min. Transfer supernate to PP bottle and label as 'AD' fraction. Add 30 mls ultrapure water, homogenize, centrifuge at 10,000 rpm for 10 min, and add supernate to PP bottle.

   Place tube with residue in drying oven overnight.

4. Add $^{232}U/^{228}Th$ spike to supernate and record spike weight.

   Spike # 25B
   Reference Activity 204.88 pCi/g
   Reference Date 1/22/93
   Spike weight .5014 g

   Add 0.5 ml Fe carrier to supernate and allow to equilibrate overnight.

5. Transfer half of solution into a large teflon beaker. Evaporate to dryness under an infrared lamp.

6. Add 20 ml of conc HNO_3 and then add 20 mls perchloric acid. Reflux gently on a hotplate until the solution has turned pale straw to water-white in color.

7. Evaporate to dryness under an infrared lamp.

8. Dissolve in 50 mls 8 M HCl and 50 mls DI water, warm on hotplate if necessary. Allow to cool.

9. Co-precipitate the U, Th, and Fe with conc ammonia added dropwise. Transfer solution to 50 ml PP centrifuge tubes, centrifuge and discard supernate. Wash with 0.05 M ammonia, centrifuge and discard washings. Precipitate is now ready for U/Th ion exchange separation.

(III) AM *Amorphous iron oxides*

1. Cool and record weight of dried residue in tube.

   Weight = 12.8202 g

2. Add 50 ml of Tamm's acid oxalate reagent to the residue in the tube. Shake for 4 hrs on wrist shaker in the dark. Check after the 1st hour and carefully release any built up pressure.

3. Centifuge quickly at 10,000 rpm for 10 min; minimize exposure to light. Transfer supernate to PP bottle and label as 'AM' fraction. Add a further 30 mls oxalate solution to the residue and shake for a further half hour.

4. Centrifuge at 10,000 rpm for 10 min, and add supernate to PP bottle. Add 30 mls ultrapure water to residue, homogenize, centrifuge, and add supernate to PP bottle.

   Place tube with residue in drying oven overnight.

5. Add $^{232}U/^{228}Th$ spike to supernate and record spike weight.

   Spike # 25B
   Reference Activity 204.68 pCi/g
   Reference Date 1/22/93
   Spike weight .9652 g

   Allow to equilibrate overnight.

6. Transfer half of solution into a large teflon beaker. Evaporate to dryness under an infrared lamp.

7. Add 20 ml of conc HNO_3 and then add 20 mls perchloric acid. Reflux gently on a hotplate until the solution has turned pale straw to water-white in color.

8. Evaporate to dryness under an infrared lamp.

9. Dissolve in 50 mls 8 M HCl and 50 mls DI water, warm on hotplate if necessary. Allow to cool.

10. Co-precipitate the U, Th, and Fe with conc ammonia added dropwise. Transfer solution to 50 ml PP centrifuge tubes, centrifuge and discard supernate. Wash with 0.05 M ammonia, centrifuge and discard washings. Precipitate is now ready for U/Th ion exchange separation.

(IV) CR *Crystalline iron oxides*

1. Cool and record weight of dried residue in tube.

   Weight = 12.7468 g

2. Add 30 ml of Coffin's reagent to the residue in the tube. Add 1.5 g (5%) of sodium dithionite ($Na_2S_2O_4$) and shake for 1 hr on wrist shaker.

3. Centifuge at10,000 rpm for 10 min. Transfer supernate to PP bottle and label as 'CR' fraction.

4. Re-extract with fresh solution if residue is not completely free of Fe (residue should be white or gray). Centrifuge at 10,000 rpm for 10 min, and add supernate to PP bottle. Add 30 mls ultrapure water to residue, homogenize, centrifuge, and add supernate to PP bottle.

   Place tube with residue in drying oven overnight.

5. Add $^{232}U/^{228}Th$ spike to supernate and record spike weight.

   Spike # 25B
   Reference Activity 204.88 pCi/g
   Reference Date 1/22/93
   Spike weight 2.7971 g

   Allow to equilibrate overnight.

6. Transfer half of solution into a large teflon beaker. Evaporate to dryness under an infrared lamp. (A crystalline crust will form and it may be necessary to break it up with a stirring rod to assist drying-out.)

7. Add conc nitric acid drop-by-drop until effervescence ceases. (Be careful, reaction can be quite violent.)

8. Evaporate to dryness under an infrared lamp.

9. Add 20 ml of conc HNO_3 and then add 20 mls perchloric acid. Reflux gently on a hotplate until the solution has turned pale straw to water-white in color.

10. Evaporate to dryness under an infrared lamp.

11. Repeat steps 9-10.

12. Dissolve in 50 mls 8 M HCl and 50 mls DI water, warm on hotplate if necessary. Allow to cool.

13. Co-precipitate the U, Th, and Fe with conc ammonia added dropwise. Transfer solution to 50 ml PP centrifuge tubes, centrifuge and discard supernate. Wash with 0.05 M ammonia, centrifuge and discard washings. Precipitate is now ready for U/Th ion exchange separation.

(V) R *Resistate (primary minerals and clays)*

1. Cool and record weight of dried residue in tube.

   Weight = 12.3380 g

2. Transfer residue to a teflon PFA vessel for microwave digestion.

3. Using a weighing boat, quantitatively add a known amount of $^{232}U/^{228}Th$ spike to the PFA vessel.

   $^{232}U/^{228}Th$ spike # 25B Reference Date 1/22/93

   Reference Activity 204.88 pCi/g Spike wt. .4996 g

3. Add reagents to vessel and record volumes:

Reagents	Volume (ml)
HF	15
HNO_3	3

4. Seal vessel, place on turntable in microwave, enter and run digestion program. Cool and vent vessel. If sample is not completely dissolved repeat step 4 .

5. Quantitatively transfer sample to a clean teflon beaker, washing the PFA vessel several times with ultrapure water.

6. Split sample into two parts: half is saved in a PP bottle for later processing if necessary and the other half is analyzed for U and Th isotopes.

7. Add 1 ml of perchloric acid ($HCLO_4$) to the sample solution in the teflon beaker. Evaporate to fumes of $HCLO_4$. Pick up in a small amount (~2 ml) of conc. HCl and dilute to approximately 2M (total ~10 ml).

8. Transfer solution to a 50 ml PP centrifuge tube. Add 0.5 ml Fe carrier and coprecipitate actinides by addition of NH_4OH to pH = 7.
   **Note: if sample already contains significant Fe, then Fe carrier does not need to be added.

9. Separate the Fe scavange by centrifugation and decant. Wash the precipitate with ultrapure water, centrifuge, and decant. Repeat washing. Precipitate is ready for ion-exchange separation.

Ion Exchange Separation - all precipitates

Dissovle the precipitates in ~3 ml conc HCl. Add 1 ml ultrapure water to dilute to ~9M.

<u>Main Column</u> (Biorad 1.5 cm diameter column with 10 cm resin; prewash with 4-5 column vols 9M HCl)

Load sample in 9M HCl and allow to drain ✓
Wash 3 volumes (~35 ml) 9M HCl --> <u>Th</u> ✓ ✓ ✓
Elute 4 volumes (~50 ml) 0.1M HCl --> <u>U and Fe</u> ✓ ✓ ✓ ✓

Separation Date 1/10/96
Except Cr 1/12/96

***Note: May work on U and Th fractions simultaneously from this point on. IE 2/7/96 review

<u>Thorium Column</u> (Biorad 0.7 cm diameter column with 10 cm resin; prewash with 4-5 column vols 8M HNO_3)

Heat Th fraction to evaporate HCl ✓
Add ~5 ml conc HNO_3 to dissolve residue ✓
Add equal vol (~5 ml) DI water so soln 8M HNO_3 ___
Load onto column in 8M HNO_3 ✓
Wash 3-4 column vols 8M HNO_3 ✓ ✓ ✓ ✓
Elute 4-5 column vols 9M HCl --> <u>Th</u> ✓ ✓ ✓ ✓

<u>Uranium Column</u> (Biorad 0.7 cm diameter column with 10 cm resin; prewash with 4-5 column vols 8M HNO_3)

Evaoprate U fraction to near dryness ✓
Pick up in about 2 ml conc HNO_3 ✓
Dilute with about 2 ml DI water to approx 8M HNO_3 ✓
Load onto column in 8M HNO_3 ✓
Wash 2 vols (8-10 ml) 8M HNO_3 --> Fe ✓ ✓ ✓ ✓
Elute 4-5 vols 0.1M HCl --> <u>U</u> ✓ ✓ ✓ ✓

Source Preparation:

Thorium - OH^- precipitation onto filter

1. Evaporate solution containing Th to near dryness.
2. Add 6 ml 0.05 M EDTA soln to dissolve residue, transfer soln to a 50 ml PP centrifuge tube and place tube in boiling water for a few minutes.
3. Add 100 µl purified cerous nitrate (0.5 mg/ml Ce) to precipitate hydroxides. Mix, add 2 drops 25% hydrazine dihydrochloride, and 2 ml of 10M NaOH.
4. Place tube in boiling water bath for 10 minutes, remove, and place tube in cold water for 10 minutes to ensure complete precipitation
5. Wet a 25 mm membrane filter with 80% ethanol and place in a 50 ml polysulfone filter funnel.
6. Shake bottle of substrate suspension (ceric hydroxide containing 10 µg Ce/ml) vigorously and draw 2 consecutive 5 ml portions through the filter with full suction. Allow each portion to suck dry for 10-15 sec.
7. Without interrupting suction, pour the sample into the filter chimney and allow to suck dry.
8. While the sample is still filtering, add 0.5 ml 10M NaOH to the sample tube and about 5 ml ultrapure water down the sides of the tube. After the sample has sucked dry, swirl the wash solution around the sides and add it to the filter chimney.
9. Wash tube, filter chimney, precipitate, and filter with three consecutive 5 ml portions of 80% ethanol.
10. Suck filter dry for about 15 sec and remove the chimney and filter carefully without interrupting the suction. Transfer filter to a plastic container and at low temperature (~60C).
11. Glue to tape the dry filter onto a 1 inch stainless steel planchet and count.

Th Counting Date ~~1/18/96~~ 1/19/96

IE 2/9/96 rev

Uranium - F^- precipitation onto filter

1. To the solution containing U, add 1 ml of 10% sodium hydrogen sulfate and 100 µl puriified cerous nitrate (0.5 mg/ml Ce, 50 µg of Ce carrier) and evaporate the solution until completely dry and no more fumes are given off.
2. Add 2 ml of 1M HCl to the beaker containing the purified U fraction and heat gently to dissolve the sodium hydrogen sulfate cake and any possible insoluble double salts with the Ce carrier.
3. Transfer solution to a 50 ml polycarbonate centrifuge tube with two more 2 ml portions of 1M HCl.
4. Add 2 drops of 20% titanium trichloride which should produce a strong violet color. If not, iron is probably present and a few more drops of titanium trichloride must be added to produce a permanent violet color or reduction and precipitation of U will be incomplete.
5. Add 0.5 ml (10 drops) of 48% HF. The violet color dissappears and any slight turbidity should clear up.
6. Mix thoroughly and allow solution to stand for 30 min in a cold water bath to obtain complete precipitation of cerous and uranous fluorides.
7. Place the tube in an ultrasonic bath for 1 min to disperse the precipitate.
8. Mount the precipitate on a 25 mm membrane filter previously treated with two 5 ml portions of cerous fluoride substrate as described above.
9. After sucking the precipitate dry, wash with 5 ml of water containing 2 drops of 48% HF and then with 80% ethanol.
10. Dry and analyze as described above.

U Counting Date 1/17/96

IE 2/9/96 rev

Procedure: The extraction, separation, and source preparation procedures shown below are used to process samples.

Sample ID # NAPI-425-PWD
Date 1/16/94

Sequential phase extractions

(I) IE *Readily ion-exchangeable*

1. Weigh 1-3 g powdered sample into a 50 ml PP centrifuge tube.

   Sample weight = 2.5291 g
   Sample weight + tube = 12.8074 g

   Add 50 ml of 1 M $MgCl_2$ at pH 7 and shake for 1 hour on wrist shaker.

2. Centrifuge at 10,000 rpm for 10 min; transfer supernate to PP bottle and label as 'IE' fraction. Add 30 ml ultrapure water to tube; homogenize; centrifuge at 10,000 rpm for 10 min and add supernate to PP bottle.

   Place tube with residue in drying oven overnight.

3. Add $^{232}U/^{228}Th$ spike to supernate and record spike weight.

   Spike # 25B
   Reference Activity 204.83 pCi/g
   Reference Date 1/22/93
   Spike weight 1.8388 g

   Add 0.5 mls Fe carrier and allow to equilibrate overnight.

4. Transfer half of solution into a 50 ml PP centrifuge tube. Add 2 mls conc HCl and mix; add ammonia solution gradually, stirring after each addition until Fe-hydroxide precipitates (red-brown).

   Note: Take care not to add too much ammonia or the Mg will precipitate too, producing a thick white precipitate. If this does happen re-dissolve in HCl and repeat precipitation.

5. Centrifuge and discard supernate. Wash with 0.05 M ammonia, centrifuge and discard washings. Precipitate is now ready for U/Th ion exchange separation.

(II). Ad *Adsorbed*

1. Cool and record weight of dried residue in tube.

   Weight = 12.7863 g

2. Add 30 ml of Morgan's reagent and 0.03 ml 0.02 M EDTA to the residue in the tube. Shake for at least 6 hrs on wrist shaker.

3. Centifuge at 10,000 rpm for 10 min. Transfer supernate to PP bottle and label as 'AD' fraction. Add 30 mls ultrapure water, homogenize, centrifuge at 10,000 rpm for 10 min, and add supernate to PP bottle.

   Place tube with residue in drying oven overnight.

4. Add $^{232}U/^{228}Th$ spike to supernate and record spike weight.

   Spike # 25B Reference Date 1/22/93
   Reference Activity 204.88 pCi/g Spike weight 1.9914 g

   Add 0.5 ml Fe carrier to supernate and allow to equilibrate overnight.

5. Transfer half of solution into a large teflon beaker. Evaporate to dryness under an infrared lamp.

6. Add 20 ml of conc HNO_3 and then add 20 mls perchloric acid. Reflux gently on a hotplate until the solution has turned pale straw to water-white in color.

7. Evaporate to dryness under an infrared lamp.

8. Dissolve in 50 mls 8 M HCl and 50 mls DI water, warm on hotplate if necessary. Allow to cool.

9. Co-precipitate the U, Th, and Fe with conc ammonia added dropwise. Transfer solution to 50 ml PP centrifuge tubes, centrifuge and discard supernate. Wash with 0.05 M ammonia, centrifuge and discard washings. Precipitate is now ready for U/Th ion exchange separation.

(III) AM *Amorphous iron oxides*

1. Cool and record weight of dried residue in tube.

   Weight = 12.7583 g

2. Add 50 ml of Tamm's acid oxalate reagent to the residue in the tube. Shake for 4 hrs on wrist shaker in the dark. Check after the 1st hour and carefully release any built up pressure.

3. Centifuge quickly at 10,000 rpm for 10 min; minimize exposure to light. Transfer supernate to PP bottle and label as 'AM' fraction. Add a further 30 mls oxalate solution to the residue and shake for a further half hour.

4. Centrifuge at 10,000 rpm for 10 min, and add supernate to PP bottle. Add 30 mls ultrapure water to residue, homogenize, centrifuge, and add supernate to PP bottle.

   Place tube with residue in drying oven overnight.

5. Add $^{232}U/^{228}Th$ spike to supernate and record spike weight.

   Spike # 25A — Reference Date 1/22/93
   Reference Activity 2.051 ~~p~~Ci/g — Spike weight .9975 g

   Allow to equilibrate overnight.

6. Transfer half of solution into a large teflon beaker. Evaporate to dryness under an infrared lamp.

7. Add 20 ml of conc HNO_3 and then add 20 mls perchloric acid. Reflux gently on a hotplate until the solution has turned pale straw to water-white in color.

8. Evaporate to dryness under an infrared lamp.

9. Dissolve in 50 mls 8 M HCl and 50 mls DI water, warm on hotplate if necessary. Allow to cool.

10. Co-precipitate the U, Th, and Fe with conc ammonia added dropwise. Transfer solution to 50 ml PP centrifuge tubes, centrifuge and discard supernate. Wash with 0.05 M ammonia, centrifuge and discard washings. Precipitate is now ready for U/Th ion exchange separation.

(IV) CR *Crystalline iron oxides*

1. Cool and record weight of dried residue in tube.

   Weight = 12.7151 g

2. Add 30 ml of Coffin's reagent to the residue in the tube. Add 1.5 g (5%) of sodium dithionite ($Na_2S_2O_4$) and shake for 1 hr on wrist shaker.

3. Centifuge at10,000 rpm for 10 min. Transfer supernate to PP bottle and label as 'CR' fraction.

4. Re-extract with fresh solution if residue is not completely free of Fe (residue should be white or gray). Centrifuge at 10,000 rpm for 10 min, and add supernate to PP bottle. Add 30 mls ultrapure water to residue, homogenize, centrifuge, and add supernate to PP bottle.

   Place tube with residue in drying oven overnight.

5. Add $^{232}U/^{228}Th$ spike to supernate and record spike weight.

   Spike # 25A
   Reference Activity 2.051 nCi/g
   Reference Date 1/22/93
   Spike weight 1.0009 g

   Allow to equilibrate overnight.

6. Transfer half of solution into a large teflon beaker. Evaporate to dryness under an infrared lamp. (A crystalline crust will form and it may be necessary to break it up with a stirring rod to assist drying-out.)

7. Add conc nitric acid drop-by-drop until effervescence ceases. (Be careful, reaction can be quite violent.)

8. Evaporate to dryness under an infrared lamp.

9. Add 20 ml of conc HNO_3 and then add 20 mls perchloric acid. Reflux gently on a hotplate until the solution has turned pale straw to water-white in color.

10. Evaporate to dryness under an infrared lamp.

11. Repeat steps 9-10.

12. Dissolve in 50 mls 8 M HCl and 50 mls DI water, warm on hotplate if necessary. Allow to cool.

13. Co-precipitate the U, Th, and Fe with conc ammonia added dropwise. Transfer solution to 50 ml PP centrifuge tubes, centrifuge and discard supernate. Wash with 0.05 M ammonia, centrifuge and discard washings. Precipitate is now ready for U/Th ion exchange separation.

(V) R *Resistate (primary minerals and clays)*

1. Cool and record weight of dried residue in tube.

   Weight = 11.4998 g

2. Transfer residue to a teflon PFA vessel for microwave digestion.

3. Using a weighing boat, quantitatively add a known amount of $^{232}U/^{228}Th$ spike to the PFA vessel.

   $^{232}U/^{228}Th$ spike # 25B Reference Date 1/22/93

   Reference Activity 204.88 pCi/g Spike wt. 1.8304 g

3. Add reagents to vessel and record volumes:

Reagents	Volume (ml)

4. Seal vessel, place on turntable in microwave, enter and run digestion program. Cool and vent vessel. If sample is not completely dissolved repeat step 4 .

5. Quantitatively transfer sample to a clean teflon beaker, washing the PFA vessel several times with ultrapure water.

6. Split sample into two parts: half is saved in a PP bottle for later processing if necessary and the other half is analyzed for U and Th isotopes.

7. Add 1 ml of perchloric acid ($HClO_4$) to the sample solution in the teflon beaker. Evaporate to fumes of $HClO_4$. Pick up in a small amount (~2 ml) of conc. HCl and dilute to approximately 2M (total ~10 ml).

8. Transfer solution to a 50 ml PP centrifuge tube. Add 0.5 ml Fe carrier and coprecipitate actinides by addition of NH_4OH to pH = 7.
   **Note: if sample already contains significant Fe, then Fe carrier does not need to be added.

9. Separate the Fe scavange by centrifugation and decant. Wash the precipitate with ultrapure water, centrifuge, and decant. Repeat washing. Precipitate is ready for ion-exchange separation.

Ion Exchange Separation - all precipitates

Dissovle the precipitates in ~3 ml conc HCl. Add 1 ml ultrapure water to dilute to ~9M.

Main Column (Biorad 1.5 cm diameter column with 10 cm resin; prewash with 4-5 column vols 9M HCl)

Load sample in 9M HCl and allow to drain	✓			
Wash 3 volumes (~35 ml) 9M HCl –> Th	✓	✓	✓	
Elute 4 volumes (~50 ml) 0.1M HCl –> U and Fe	✓	___	___	___

Separation Date 2/5/96

AM 2/12/96

***Note: May work on U and Th fractions simultaneously from this point on.

Thorium Column (Biorad 0.7 cm diameter column with 10 cm resin; prewash with 4-5 column vols 8M HNO_3)

Heat Th fraction to evaporate HCl	✓			
Add ~5 ml conc HNO_3 to dissolve residue	✓			
Add equal vol (~5 ml) DI water so soln 8M HNO_3	✓			
Load onto column in 8M HNO_3	✓			
Wash 3-4 column vols 8M HNO_3	✓	✓	✓	
Elute 4-5 column vols 9M HCl –> Th	✓	✓	✓	___

Uranium Column (Biorad 0.7 cm diameter column with 10 cm resin; prewash with 4-5 column vols 8M HNO_3)

Evaoprate U fraction to near dryness	✓			
Pick up in about 2 ml conc HNO_3	✓			
Dilute with about 2 ml DI water to approx 8M HNO_3	✓			
Load onto column in 8M HNO_3	✓			
Wash 2 vols (8-10 ml) 8M HNO_3 –> Fe	✓	✓		
Elute 4-5 vols 0.1M HCl –> U	✓	✓	✓	✓

Source Preparation:

Thorium - OH- precipitation onto filter

1. Evaporate solution containing Th to near dryness.
2. Add 6 ml 0.05 M EDTA soln to dissolve residue, transfer soln to a 50 ml PP centrifuge tube and place tube in boiling water for a few minutes.
3. Add 100 µl purified cerous nitrate (0.5 mg/ml Ce) to precipitate hydroxides. Mix, add 2 drops 25% hydrazine dihydrochloride, and 2 ml of 10M NaOH.
4. Place tube in boiling water bath for 10 minutes, remove, and place tube in cold water for 10 minutes to ensure complete precipitation
5. Wet a 25 mm membrane filter with 80% ethanol and place in a 50 ml polysulfone filter funnel.
6. Shake bottle of substrate suspension (ceric hydroxide containing 10 µg Ce/ml) vigorously and draw 2 consecutive 5 ml portions through the filter with full suction. Allow each portion to suck dry for 10-15 sec.
7. Without interrupting suction, pour the sample into the filter chimney and allow to suck dry.
8. While the sample is still filtering, add 0.5 ml 10M NaOH to the sample tube and about 5 ml ultrapure water down the sides of the tube. After the sample has sucked dry, swirl the wash solution around the sides and add it to the filter chimney.
9. Wash tube, filter chimney, precipitate, and filter with three consecutive 5 ml portions of 80% ethanol.
10. Suck filter dry for about 15 sec and remove the chimney and filter carefully without interrupting the suction. Transfer filter to a plastic container and at low temperature (~60C).
11. Glue to tape the dry filter onto a 1 inch stainless steel planchet and count.

Th Counting Date 2/7/96

ThCR - 2/10/96
~~[illegible]~~
AM - 2/14/96

Uranium - F- precipitation onto filter

1. To the solution containing U, add 1 ml of 10% sodium hydrogen sulfate and 100 µl puriified cerous nitrate (0.5 mg/ml Ce, 50 µg of Ce carrier) and evaporate the solution until completely dry and no more fumes are given off.
2. Add 2 ml of 1M HCl to the beaker containing the purified U fraction and heat gently to dissolve the sodium hydrogen sulfate cake and any possible insoluble double salts with the Ce carrier.
3. Transfer solution to a 50 ml polycarbonate centrifuge tube with two more 2 ml portions of 1M HCl.
4. Add 2 drops of 20% titanium trichloride which should produce a strong violet color. If not, iron is probably present and a few more drops of titanium trichloride must be added to produce a permanent violet color or reduction and precipitation of U will be incomplete.
5. Add 0.5 ml (10 drops) of 48% HF. The violet color dissappears and any slight turbidity should clear up.
6. Mix thoroughly and allow solution to stand for 30 min in a cold water bath to obtain complete precipitation of cerous and uranous fluorides.
7. Place the tube in an ultrasonic bath for 1 min to disperse the precipitate.
8. Mount the precipitate on a 25 mm membrane filter previously treated with two 5 ml portions of cerous fluoride substrate as described above.
9. After sucking the precipitate dry, wash with 5 ml of water containing 2 drops of 48% HF and then with 80% ethanol.
10. Dry and analyze as described above.

U Counting Date 2/7/96

ThCR 2/10/96
AM 2/14/96

Procedure: The extraction, separation, and source preparation procedures shown below are used to process samples.

Sample ID # NOPI-425-PND
Date 5/9/96

Sequential phase extractions

(I) IE *Readily ion-exchangeable*

1. Weigh 1-3 g powdered sample into a 50 ml PP centrifuge tube.

   Sample weight = 2.5059 g
   Sample weight + tube = 12.9104 g .0129

   Add 50 ml of 1 M $MgCl_2$ at pH 7 and shake for 1 hour on wrist shaker.

2. Centrifuge at 10,000 rpm for 10 min; transfer supernate to PP bottle and label as 'IE' fraction. Add 30 ml ultrapure water to tube; homogenize; centrifuge at 10,000 rpm for 10 min and add supernate to PP bottle.

   Place tube with residue in drying oven overnight.

3. Add $^{232}U/^{228}Th$ spike to supernate and record spike weight.

   Spike # 25B
   Reference Activity 204.89 pCi/g
   Reference Date 1/22/93
   Spike weight ~~1.0046~~ .5023 g

   Add 0.5 mls Fe carrier and allow to equilibrate overnight.

4. Transfer half of solution into a 50 ml PP centrifuge tube. Add 2 mls conc HCl and mix; add ammonia solution gradually, stirring after each addition until Fe-hydroxide precipiates (red-brown).

   Note: Take care not to add too much ammonia or the Mg will precipitate too, producing a thick white precipitate. If this does happen re-dissolve in HCl and repeat precipitation.

5. Centrifuge and discard supernate. Wash with 0.05 M ammonia, centrifuge and discard washings. Precipitate is now ready for U/Th ion exchange separation.

(II). Ad *Adsorbed*

1. Cool and record weight of dried residue in tube.

   Weight = 12.8975 g .6446

2. Add 30 ml of Morgan's reagent and 2.0 ml 0.3 M EDTA to the residue in the tube. Shake for at least 6 hrs on wrist shaker.

3. Centifuge at 10,000 rpm for 10 min. Transfer supernate to PP bottle and label as 'AD' fraction. Add 30 mls ultrapure water, homogenize, centrifuge at 10,000 rpm for 10 min, and add supernate to PP bottle.

   Place tube with residue in drying oven overnight.

4. Add $^{232}U/^{228}Th$ spike to supernate and record spike weight.

   Spike # 25A
   Reference Activity 2.051 pCi/g
   Reference Date 1/22/93
   Spike weight 1.1057 g

   Add 0.5 ml Fe carrier to supernate and allow to equilibrate overnight.

5. Transfer half of solution into a large teflon beaker. Evaporate to dryness under an infrared lamp.

6. Add 20 ml of conc HNO_3 and then add 20 mls perchloric acid. Reflux gently on a hotplate until the solution has turned pale straw to water-white in color.

7. Evaporate to dryness under an infrared lamp.

8. Dissolve in 50 mls 8 M HCl and 50 mls DI water, warm on hotplate if necessary. Allow to cool.

9. Co-precipitate the U, Th, and Fe with conc ammonia added dropwise. Transfer solution to 50 ml PP centrifuge tubes, centrifuge and discard supernate. Wash with 0.05 M ammonia, centrifuge and discard washings. Precipitate is now ready for U/Th ion exchange separation.

(III) AM *Amorphous iron oxides*

1. Cool and record weight of dried residue in tube.

   Weight = 12.8529 g   .0794

2. Add 50 ml of Tamm's acid oxalate reagent to the residue in the tube. Shake for 4 hrs on wrist shaker in the dark. Check after the 1st hour and carefully release any built up pressure.

3. Centifuge quickly at 10,000 rpm for 10 min; minimize exposure to light. Transfer supernate to PP bottle and label as 'AM' fraction. Add a further 30 mls oxalate solution to the residue and shake for a further half hour.

4. Centrifuge at 10,000 rpm for 10 min, and add supernate to PP bottle. Add 30 mls ultrapure water to residue, homogenize, centrifuge, and add supernate to PP bottle.

   Place tube with residue in drying oven overnight.

5. Add $^{232}U/^{228}Th$ spike to supernate and record spike weight.

   Spike # 25A   Reference Date 1/22/93
   Reference Activity 2.051 μCi/g   Spike weight .5008 g

   Allow to equilibrate overnight.

6. Transfer half of solution into a large teflon beaker. Evaporate to dryness under an infrared lamp.

7. Add 20 ml of conc HNO_3 and then add 20 mls perchloric acid. Reflux gently on a hotplate until the solution has turned pale straw to water-white in color.

8. Evaporate to dryness under an infrared lamp.

9. Dissolve in 50 mls 8 M HCl and 50 mls DI water, warm on hotplate if necessary. Allow to cool.

10. Co-precipitate the U, Th, and Fe with conc ammonia added dropwise. Transfer solution to 50 ml PP centrifuge tubes, centrifuge and discard supernate. Wash with 0.05 M ammonia, centrifuge and discard washings. Precipitate is now ready for U/Th ion exchange separation.

(IV) CR *Crystalline iron oxides*

1. Cool and record weight of dried residue in tube.

   Weight = 12.7735 g 1.0616

2. Add 30 ml of Coffin's reagent to the residue in the tube. Add 1.5 g (5%) of sodium dithionite ($Na_2S_2O_4$) and shake for 1 hr on wrist shaker.

3. Centifuge at10,000 rpm for 10 min. Transfer supernate to PP bottle and label as 'CR' fraction.

4. Re-extract with fresh solution if residue is not completely free of Fe (residue should be white or gray). Centrifuge at 10,000 rpm for 10 min, and add supernate to PP bottle. Add 30 mls ultrapure water to residue, homogenize, centrifuge, and add supernate to PP bottle.

   Place tube with residue in drying oven overnight.

5. Add $^{232}U/^{228}Th$ spike to supernate and record spike weight.

   Spike # 25B
   Reference Activity 204.88 pCi/g
   Reference Date 1/22/93
   Spike weight 1.0307 g

   Allow to equilibrate overnight.

6. Transfer half of solution into a large teflon beaker. Evaporate to dryness under an infrared lamp. (A crystalline crust will form and it may be necessary to break it up with a stirring rod to assist drying-out.)

7. Add conc nitric acid drop-by-drop until effervescence ceases. (Be careful, reaction can be quite violent.)

8. Evaporate to dryness under an infrared lamp.

9. Add 20 ml of conc HNO_3 and then add 20 mls perchloric acid. Reflux gently on a hotplate until the solution has turned pale straw to water-white in color.

10. Evaporate to dryness under an infrared lamp.

11. Repeat steps 9-10.

12. Dissolve in 50 mls 8 M HCl and 50 mls DI water, warm on hotplate if necessary. Allow to cool.

13. Co-precipitate the U, Th, and Fe with conc ammonia added dropwise. Transfer solution to 50 ml PP centrifuge tubes, centrifuge and discard supernate. Wash with 0.05 M ammonia, centrifuge and discard washings. Precipitate is now ready for U/Th ion exchange separation.

(V) R *Resistate (primary minerals and clays)*

1. Cool and record weight of dried residue in tube.

   Weight = 11.7119 g 1.3074

2. Transfer residue to a teflon PFA vessel for microwave digestion.

3. Using a weighing boat, quantitatively add a known amount of $^{232}U/^{228}Th$ spike to the PFA vessel.

   $^{232}U/^{228}Th$ spike # 25B Reference Date 1/22/93

   Reference Activity 204.88 dCi/g Spike wt. ~~1.0134~~ g .5026

3. Add reagents to vessel and record volumes:

Reagents	Volume (ml)
HF	15
HNO_3	3

4. Seal vessel, place on turntable in microwave, enter and run digestion program. Cool and vent vessel. If sample is not completely dissolved repeat step 4 .

5. Quantitatively transfer sample to a clean teflon beaker, washing the PFA vessel several times with ultrapure water.

6. Split sample into two parts: half is saved in a PP bottle for later processing if necessary and the other half is analyzed for U and Th isotopes.

7. Add 1 ml of perchloric acid ($HClO_4$) to the sample solution in the teflon beaker. Evaporate to fumes of $HClO_4$. Pick up in a small amount (~2 ml) of conc. HCl and dilute to approximately 2M (total ~10 ml).

8. Transfer solution to a 50 ml PP centrifuge tube. Add 0.5 ml Fe carrier and coprecipitate actinides by addition of NH_4OH to pH = 7.

   **Note: if sample already contains significant Fe, then Fe carrier does not need to be added.

9. Separate the Fe scavange by centrifugation and decant. Wash the precipitate with ultrapure water, centrifuge, and decant. Repeat washing. Precipitate is ready for ion-exchange separation.

Ion Exchange Separation - all precipitates

Dissovle the precipitates in ~3 ml conc HCl. Add 1 ml ultrapure water to dilute to ~9M.

Main Column (Biorad 1.5 cm diameter column with 10 cm resin; prewash with 4-5 column vols 9M HCl)

Load sample in 9M HCl and allow to drain	✓
Wash 3 volumes (~35 ml) 9M HCl --> Th	✓ ✓ ✓
Elute 4 volumes (~50 ml) 0.1M HCl --> U and Fe	✓ ✓ ✓ ✓

Separation Date 5/27/96 IE
6/17/96 AD, AM, CR, RES

***Note: May work on U and Th fractions simultaneously from this point on.

Thorium Column (Biorad 0.7 cm diameter column with 10 cm resin; prewash with 4-5 column vols 8M HNO_3)

Heat Th fraction to evaporate HCl	✓
Add ~5 ml conc HNO_3 to dissolve residue	✓
Add equal vol (~5 ml) DI water so soln 8M HNO_3	✓
Load onto column in 8M HNO_3	✓
Wash 3-4 column vols 8M HNO_3	✓ ✓ ✓
Elute 4-5 column vols 9M HCl --> Th	✓ ___ ___ ___

Uranium Column (Biorad 0.7 cm diameter column with 10 cm resin; prewash with 4-5 column vols 8M HNO_3)

Evaoprate U fraction to near dryness	✓
Pick up in about 2 ml conc HNO_3	✓
Dilute with about 2 ml DI water to approx 8M HNO_3	✓
Load onto column in 8M HNO_3	✓
Wash 2 vols (8-10 ml) 8M HNO_3 --> Fe	✓ ✓
Elute 4-5 vols 0.1M HCl --> U	✓ ✓ ✓ ✓

Source Preparation:

Thorium - OH^- precipitation onto filter

1. Evaporate solution containing Th to near dryness.
2. Add 6 ml 0.05 M EDTA soln to dissolve residue, transfer soln to a 50 ml PP centrifuge tube and place tube in boiling water for a few minutes.
3. Add 100 µl purified cerous nitrate (0.5 mg/ml Ce) to precipitate hydroxides. Mix, add 2 drops 25% hydrazine dihydrochloride, and 2 ml of 10M NaOH.
4. Place tube in boiling water bath for 10 minutes, remove, and place tube in cold water for 10 minutes to ensure complete precipitation
5. Wet a 25 mm membrane filter with 80% ethanol and place in a 50 ml polysulfone filter funnel.
6. Shake bottle of substrate suspension (ceric hydroxide containing 10 µg Ce/ml) vigorously and draw 2 consecutive 5 ml portions through the filter with full suction. Allow each portion to suck dry for 10-15 sec.
7. Without interrupting suction, pour the sample into the filter chimney and allow to suck dry.
8. While the sample is still filtering, add 0.5 ml 10M NaOH to the sample tube and about 5 ml ultrapure water down the sides of the tube. After the sample has sucked dry, swirl the wash solution around the sides and add it to the filter chimney.
9. Wash tube, filter chimney, precipitate, and filter with three consecutive 5 ml portions of 80% ethanol.
10. Suck filter dry for about 15 sec and remove the chimney and filter carefully without interrupting the suction. Transfer filter to a plastic container and at low temperature (~60C).
11. Glue to tape the dry filter onto a 1 inch stainless steel planchet and count.

Th Counting Date 7/19/96 IE, AO, Am, CR
7/22/96 RES

Uranium - F^- precipitation onto filter

1. To the solution containing U, add 1 ml of 10% sodium hydrogen sulfate and 100 µl puriified cerous nitrate (0.5 mg/ml Ce, 50 µg of Ce carrier) and evaporate the solution until completely dry and no more fumes are given off.
2. Add 2 ml of 1M HCl to the beaker containing the purified U fraction and heat gently to dissolve the sodium hydrogen sulfate cake and any possible insoluble double salts with the Ce carrier.
3. Transfer solution to a 50 ml polycarbonate centrifuge tube with two more 2 ml portions of 1M HCl.
4. Add 2 drops of 20% titanium trichloride which should produce a strong violet color. If not, iron is probably present and a few more drops of titanium trichloride must be added to produce a permanent violet color or reduction and precipitation of U will be incomplete.
5. Add 0.5 ml (10 drops) of 48% HF. The violet color dissappears and any slight turbidity should clear up.
6. Mix thoroughly and allow solution to stand for 30 min in a cold water bath to obtain complete precipitation of cerous and uranous fluorides.
7. Place the tube in an ultrasonic bath for 1 min to disperse the precipitate.
8. Mount the precipitate on a 25 mm membrane filter previously treated with two 5 ml portions of cerous fluoride substrate as described above.
9. After sucking the precipitate dry, wash with 5 ml of water containing 2 drops of 48% HF and then with 80% ethanol.
10. Dry and analyze as described above.

U Counting Date 7/17/96

SEQUENTIAL PHASE EXTRACTIONS

Objective: determine U and Th content and activity ratios in different phases in samples from Nopal I

Method: sequential phase extraction; alpha spectrometry

Equipment:
-EG&G Ortec alpha spectrometry system
  576A dual or 676 single chamber detectors
  Model 920 multichannel buffer
  ALPHAMAT analysis software for acquisition control
  MAESTRO II software for data analysis
-perchloric fume hood
-drying oven (Blue M)
-analytical balance
-Fisher 21K Marathon centrifuge
-SI Vortex Genie hand homogenizer
-Burrell wrist shaker
-Corning hot plates
-Infrared lamp
-CEM Model MDS-2000 microwave digestion system
-Teflon PFA vessels
-ultrasonic bath

Materials and Supplies:
-necessary glassware (e.g., beakers, flasks, etc...)
-necessary platicware (e.g., PP bottles, beakers, etc...)
-50 ml polypropylene and teflon centrifuge tubes
-Eppendorf pipets and tips
-Teflon beakers
-filters and filter funnels
-Bio-Rad columns 1.5 cm diameter
-Bio-Rad columns 0.7 cm diameter
-Bio-Rad anion exchange resin AG 1-X8 100-200 mesh
-$^{232}U/^{228}Th$ spike solutions prepared previously
-weighing paper and boats
-PP bottles
-1 inch stainless steel planchets
-25 mm membrane filters
-50 ml polysulfone filter funnel

Reagents:
-Conc HCl, $HClO_4$, NH_4OH, HNO_3, HF, acetic acid, ammonia
-9M, 0.1M, 1M, 8M HCl
-0.1M, 8M HNO_3
-0.05, 0.3 M EDTA solution
-0.05 ammonia
-Cerous nitrate (0.5 mg/ml Ce)
-25% hydrazine dihydrochloride
-10 M NaOH
-80% ethanol
-Ceric hydroxide (10 μg Ce/ml) substrate
-10% sodium hydrogen sulfate
-20% titanium chloride

-Cerous fluoride (10 μg Ce/ml) substrate

-sodium dithionite ($Na_2S_2O_4$)

-1 M $MgCl_2$ - 203.3 g $MgCl_2$ dissolved in 1L DI water at pH 7

-Tamm's reagent - 28.4 g ammonium oxalate dissolved in DI water, mixed with 25.2 g oxalic acid dissolved in DI water, made up to 1L

-Fe carrier solution (10 mg/ml) - 72.3 g ferric nitrate dissolved in DI water, 50 ml conc HNO_3 added, made up to 1L with DI water

-Morgan's reagent - 82.04 g sodium acetate dissolved in 1L DI water, adjusted to pH 5 with acetic acid

-Coffin's reagent - 51.5 g sodium citrate dissolved in DI water, mixed with 5.25 g citric acid dissolved in DI water, made up to 1L

Procedure: The extraction, separation, and source preparation procedures shown below are used to process samples.

Sample ID # ________________
Date ________________

Sequential phase extractions

(I) IE *Readily ion-exchangeable*

1. Weigh 1-3 g powdered sample into a 50 ml PP centrifuge tube.

   Sample weight = _________ g
   Sample weight + tube = __________g

   Add 50 ml of 1 M $MgCl_2$ at pH 7 and shake for 1 hour on wrist shaker.

2. Centrifuge at 10,000 rpm for 10 min; transfer supernate to PP bottle and label as 'IE' fraction. Add 30 ml ultrapure water to tube; homogenize; centrifuge at 10,000 rpm for 10 min and add supernate to PP bottle.

   Place tube with residue in drying oven overnight.

3. Add $^{232}U/^{228}Th$ spike to supernate and record spike weight.

   Spike # ________ Reference Date _________
   Reference Activity _________pCi/g Spike weight _________ g

   Add 0.5 mls Fe carrier and allow to equilibrate overnight.

4. Transfer half of solution into a 50 ml PP centrifuge tube. Add 2 mls conc HCl and mix; add ammonia solution gradually, stirring after each addition until Fe-hydroxide precipiates (red-brown).

   Note: Take care not to add too much ammonia or the Mg will precipitate too, producing a thick white precipitate. If this does happen re-dissolve in HCl and repeat precipitation.

5. Centrifuge and discard supernate. Wash with 0.05 M ammonia, centrifuge and discard washings. Precipitate is now ready for U/Th ion exchange separation.

(II). Ad *Adsorbed*

1. Cool and record weight of dried residue in tube.

   Weight = __________ g

2. Add 30 ml of Morgan's reagent and 2.0 ml 0.3 M EDTA to the residue in the tube. Shake for at least 6 hrs on wrist shaker.

3. Centifuge at 10,000 rpm for 10 min. Transfer supernate to PP bottle and label as 'AD' fraction. Add 30 mls ultrapure water, homogenize, centrifuge at 10,000 rpm for 10 min, and add supernate to PP bottle.

   Place tube with residue in drying oven overnight.

4. Add $^{232}U/^{228}Th$ spike to supernate and record spike weight.

   Spike # ________ Reference Date _________
   Reference Activity _________pCi/g Spike weight _________ g

   Add 0.5 ml Fe carrier to supernate and allow to equilibrate overnight.

5. Transfer half of solution into a large teflon beaker. Evaporate to dryness under an infrared lamp.

6. Add 20 ml of conc HNO_3 and then add 20 mls perchloric acid. Reflux gently on a hotplate until the solution has turned pale straw to water-white in color.

7. Evaporate to dryness under an infrared lamp.

8. Dissolve in 50 mls 8 M HCl and 50 mls DI water, warm on hotplate if necessary. Allow to cool.

9. Co-precipitate the U, Th, and Fe with conc ammonia added dropwise. Transfer solution to 50 ml PP centrifuge tubes, centrifuge and discard supernate. Wash with 0.05 M ammonia, centrifuge and discard washings. Precipitate is now ready for U/Th ion exchange separation.

(III) AM *Amorphous iron oxides*

1. Cool and record weight of dried residue in tube.

   Weight = __________ g

2. Add 50 ml of Tamm's acid oxalate reagent to the residue in the tube. Shake for 4 hrs on wrist shaker in the dark. Check after the 1st hour and carefully release any built up pressure.

3. Centifuge quickly at 10,000 rpm for 10 min; minimize exposure to light. Transfer supernate to PP bottle and label as 'AM' fraction. Add a further 30 mls oxalate solution to the residue and shake for a further half hour.

4. Centrifuge at 10,000 rpm for 10 min, and add supernate to PP bottle. Add 30 mls ultrapure water to residue, homogenize, centrifuge, and add supernate to PP bottle.

   Place tube with residue in drying oven overnight.

5. Add $^{232}U/^{228}Th$ spike to supernate and record spike weight.

   Spike # ________ Reference Date _________
   Reference Activity _________pCi/g Spike weight _________ g

   Allow to equilibrate overnight.

6. Transfer half of solution into a large teflon beaker. Evaporate to dryness under an infrared lamp.

7. Add 20 ml of conc HNO_3 and then add 20 mls perchloric acid. Reflux gently on a hotplate until the solution has turned pale straw to water-white in color.

8. Evaporate to dryness under an infrared lamp.

9. Dissolve in 50 mls 8 M HCl and 50 mls DI water, warm on hotplate if necessary. Allow to cool.

10. Co-precipitate the U, Th, and Fe with conc ammonia added dropwise. Transfer solution to 50 ml PP centrifuge tubes, centrifuge and discard supernate. Wash with 0.05 M ammonia, centrifuge and discard washings. Precipitate is now ready for U/Th ion exchange separation.

(IV) CR *Crystalline iron oxides*

1. Cool and record weight of dried residue in tube.

   Weight = __________ g

2. Add 30 ml of Coffin's reagent to the residue in the tube. Add 1.5 g (5%) of sodium dithionite ($Na_2S_2O_4$) and shake for 1 hr on wrist shaker.

3. Centifuge at10,000 rpm for 10 min. Transfer supernate to PP bottle and label as 'CR' fraction.

4. Re-extract with fresh solution if residue is not completely free of Fe (residue should be white or gray). Centrifuge at 10,000 rpm for 10 min, and add supernate to PP bottle. Add 30 mls ultrapure water to residue, homogenize, centrifuge, and add supernate to PP bottle.

   Place tube with residue in drying oven overnight.

5. Add $^{232}U/^{228}Th$ spike to supemate and record spike weight.

   Spike # ________ Reference Date ________
   Reference Activity ________pCi/g Spike weight ________ g

   Allow to equilibrate overnight.

6. Transfer half of solution into a large teflon beaker. Evaporate to dryness under an infrared lamp. (A crystalline crust will form and it may be necessary to break it up with a stirring rod to assist drying-out.)

7. Add conc nitric acid drop-by-drop until effervescence ceases. (Be careful, reaction can be quite violent.)

8. Evaporate to dryness under an infrared lamp.

9. Add 20 ml of conc HNO_3 and then add 20 mls perchloric acid. Reflux gently on a hotplate until the solution has turned pale straw to water-white in color.

10. Evaporate to dryness under an infrared lamp.

11. Repeat steps 9-10.

12. Dissolve in 50 mls 8 M HCl and 50 mls DI water, warm on hotplate if necessary. Allow to cool.

13. Co-precipitate the U, Th, and Fe with conc ammonia added dropwise. Transfer solution to 50 ml PP centrifuge tubes, centrifuge and discard supernate. Wash with 0.05 M ammonia, centrifuge and discard washings. Precipitate is now ready for U/Th ion exchange separation.

(V) R *Resistate (primary minerals and clays)*

1. Cool and record weight of dried residue in tube.

   Weight = __________ g

2. Transfer residue to a teflon PFA vessel for microwave digestion.

3. Using a weighing boat, quantitatively add a known amount of $^{232}U/^{228}Th$ spike to the PFA vessel.

   $^{232}U/^{228}Th$ spike # ________ Reference Date _________

   Reference Activity ________pCi/g Spike wt. ________g

3. Add reagents to vessel and record volumes:

Reagents	Volume (ml)
_____________	____________
_____________	____________
_____________	____________
_____________	____________

4. Seal vessel, place on turntable in microwave, enter and run digestion program. Cool and vent vessel. If sample is not completely dissolved repeat step 4 .

5. Quantitatively transfer sample to a clean teflon beaker, washing the PFA vessel several times with ultrapure water.

6. Split sample into two parts: half is saved in a PP bottle for later processing if necessary and the other half is analyzed for U and Th isotopes.

7. Add 1 ml of perchloric acid ($HClO_4$) to the sample solution in the teflon beaker. Evaporate to fumes of $HClO_4$. Pick up in a small amount (~2 ml) of conc. HCl and dilute to approximately 2M (total ~10 ml).

8. Transfer solution to a 50 ml PP centrifuge tube. Add 0.5 ml Fe carrier and coprecipitate actinides by addition of NH_4OH to pH = 7.
   **Note: if sample already contains significant Fe, then Fe carrier does not need to be added.

9. Separate the Fe scavange by centrifugation and decant. Wash the precipitate with ultrapure water, centrifuge, and decant. Repeat washing. Precipitate is ready for ion-exchange separation.

Ion Exchange Separation - all precipitates

Dissovle the precipitates in ~3 ml conc HCl. Add 1 ml ultrapure water to dilute to ~9M.

Main Column (Biorad 1.5 cm diameter column with 10 cm resin; prewash with 4-5 column vols 9M HCl)

Load sample in 9M HCl and allow to drain	___			
Wash 3 volumes (~35 ml) 9M HCl --> Th	___	___	___	
Elute 4 volumes (~50 ml) 0.1M HCl --> U and Fe	___	___	___	___

Separation Date ______________

***Note: May work on U and Th fractions simultaneously from this point on.

Thorium Column (Biorad 0.7 cm diameter column with 10 cm resin; prewash with 4-5 column vols 8M HNO_3)

Heat Th fraction to evaporate HCl	___			
Add ~5 ml conc HNO_3 to dissolve residue	___			
Add equal vol (~5 ml) DI water so soln 8M HNO_3	___			
Load onto column in 8M HNO_3	___			
Wash 3-4 column vols 8M HNO_3	___	___	___	
Elute 4-5 column vols 9M HCl --> Th	___	___	___	___

Uranium Column (Biorad 0.7 cm diameter column with 10 cm resin; prewash with 4-5 column vols 8M HNO_3)

Evaoprate U fraction to near dryness	___			
Pick up in about 2 ml conc HNO_3	___			
Dilute with about 2 ml DI water to approx 8M HNO_3	___			
Load onto column in 8M HNO_3	___			
Wash 2 vols (8-10 ml) 8M HNO_3 --> Fe	___	___		
Elute 4-5 vols 0.1M HCl --> U	___	___	___	___

Source Preparation:

Thorium - OH^- precipitation onto filter

1. Evaporate solution containing Th to near dryness.
2. Add 6 ml 0.05 M EDTA soln to dissolve residue, transfer soln to a 50 ml PP centrifuge tube and place tube in boiling water for a few minutes.
3. Add 100 µl purified cerous nitrate (0.5 mg/ml Ce) to precipitate hydroxides. Mix, add 2 drops 25% hydrazine dihydrochloride, and 2 ml of 10M NaOH.
4. Place tube in boiling water bath for 10 minutes, remove, and place tube in cold water for 10 minutes to ensure complete precipitation
5. Wet a 25 mm membrane filter with 80% ethanol and place in a 50 ml polysulfone filter funnel.
6. Shake bottle of substrate suspension (ceric hydroxide containing 10 µg Ce/ml) vigorously and draw 2 consecutive 5 ml portions through the filter with full suction. Allow each portion to suck dry for 10-15 sec.
7. Without interrupting suction, pour the sample into the filter chimney and allow to suck dry.
8. While the sample is still filtering, add 0.5 ml 10M NaOH to the sample tube and about 5 ml ultrapure water down the sides of the tube. After the sample has sucked dry, swirl the wash solution around the sides and add it to the filter chimney.
9. Wash tube, filter chimney, precipitate, and filter with three consecutive 5 ml portions of 80% ethanol.
10. Suck filter dry for about 15 sec and remove the chimney and filter carefully without interrupting the suction. Transfer filter to a plastic container and at low temperature (~60C).
11. Glue to tape the dry filter onto a 1 inch stainless steel planchet and count.

Th Counting Date______________

Uranium - F^- precipitation onto filter

1. To the solution containing U, add 1 ml of 10% sodium hydrogen sulfate and 100 µl puriified cerous nitrate (0.5 mg/ml Ce, 50 µg of Ce carrier) and evaporate the solution until completely dry and no more fumes are given off.
2. Add 2 ml of 1M HCl to the beaker containing the purified U fraction and heat gently to dissolve the sodium hydrogen sulfate cake and any possible insoluble double salts with the Ce carrier.
3. Transfer solution to a 50 ml polycarbonate centrifuge tube with two more 2 ml portions of 1M HCl.
4. Add 2 drops of 20% titanium trichloride which should produce a strong violet color. If not, iron is probably present and a few more drops of titanium trichloride must be added to produce a permanent violet color or reduction and precipitation of U will be incomplete.
5. Add 0.5 ml (10 drops) of 48% HF. The violet color dissappears and any slight turbidity should clear up.
6. Mix thoroughly and allow solution to stand for 30 min in a cold water bath to obtain complete precipitation of cerous and uranous fluorides.
7. Place the tube in an ultrasonic bath for 1 min to disperse the precipitate.
8. Mount the precipitate on a 25 mm membrane filter previously treated with two 5 ml portions of cerous fluoride substrate as described above.
9. After sucking the precipitate dry, wash with 5 ml of water containing 2 drops of 48% HF and then with 80% ethanol.
10. Dry and analyze as described above.

U Counting Date_______________

Procedure: The extraction, separation, and source preparation procedures shown below are used to process samples.

Sample ID # ______________

Date ______________

Sequential phase extractions

(I) IE *Readily ion-exchangeable*

1. Weigh 1-3 g powdered sample into a 50 ml PP centrifuge tube.

   Sample weight = ________ g
   Sample weight + tube = _________g

   Add 50 ml of 1 M $MgCl_2$ at pH 7 and shake for 1 hour on wrist shaker.

2. Centrifuge at 10,000 rpm for 10 min; transfer supernate to PP bottle and label as 'IE' fraction. Add 30 ml ultrapure water to tube; homogenize; centrifuge at 10,000 rpm for 10 min and add supernate to PP bottle.

   Place tube with residue in drying oven overnight.

3. Add $^{232}U/^{228}Th$ spike to supernate and record spike weight.

   Spike # _______ Reference Date ________
   Reference Activity _________pCi/g Spike weight ________ g

   Add 0.5 mls Fe carrier and allow to equilibrate overnight.

4. Transfer half of solution into a 50 ml PP centrifuge tube. Add 2 mls conc HCl and mix; add ammonia solution gradually, stirring after each addition until Fe-hydroxide precipitates (red-brown).

   Note: Take care not to add too much ammonia or the Mg will precipitate too, producing a thick white precipitate. If this does happen re-dissolve in HCl and repeat precipitation.

5. Centrifuge and discard supernate. Wash with 0.05 M ammonia, centrifuge and discard washings. Precipitate is now ready for U/Th ion exchange separation.

(II). Ad *Adsorbed*

1. Cool and record weight of dried residue in tube.

   Weight = __________ g

2. Add 30 ml of Morgan's reagent and 2.0 ml 0.3 M EDTA to the residue in the tube. Shake for at least 6 hrs on wrist shaker.

3. Centifuge at 10,000 rpm for 10 min. Transfer supernate to PP bottle and label as 'AD' fraction. Add 30 mls ultrapure water, homogenize, centrifuge at 10,000 rpm for 10 min, and add supernate to PP bottle.

   Place tube with residue in drying oven overnight.

4. Add $^{232}U/^{228}Th$ spike to supernate and record spike weight.

   Spike # ________ Reference Date ________
   Reference Activity ________pCi/g Spike weight ________ g

   Add 0.5 ml Fe carrier to supernate and allow to equilibrate overnight.

5. Transfer half of solution into a large teflon beaker. Evaporate to dryness under an infrared lamp.

6. Add 20 ml of conc HNO_3 and then add 20 mls perchloric acid. Reflux gently on a hotplate until the solution has turned pale straw to water-white in color.

7. Evaporate to dryness under an infrared lamp.

8. Dissolve in 50 mls 8 M HCl and 50 mls DI water, warm on hotplate if necessary. Allow to cool.

9. Co-precipitate the U, Th, and Fe with conc ammonia added dropwise. Transfer solution to 50 ml PP centrifuge tubes, centrifuge and discard supernate. Wash with 0.05 M ammonia, centrifuge and discard washings. Precipitate is now ready for U/Th ion exchange separation.

(III) AM *Amorphous iron oxides*

1. Cool and record weight of dried residue in tube.

   Weight = __________ g

2. Add 50 ml of Tamm's acid oxalate reagent to the residue in the tube. Shake for 4 hrs on wrist shaker in the dark. Check after the 1st hour and carefully release any built up pressure.

3. Centifuge quickly at 10,000 rpm for 10 min; minimize exposure to light. Transfer supernate to PP bottle and label as 'AM' fraction. Add a further 30 mls oxalate solution to the residue and shake for a further half hour.

4. Centrifuge at 10,000 rpm for 10 min, and add supernate to PP bottle. Add 30 mls ultrapure water to residue, homogenize, centrifuge, and add supernate to PP bottle.

   Place tube with residue in drying oven overnight.

5. Add $^{232}U/^{228}Th$ spike to supernate and record spike weight.

   Spike # ________ Reference Date _________
   Reference Activity _________pCi/g Spike weight _________ g

   Allow to equilibrate overnight.

6. Transfer half of solution into a large teflon beaker. Evaporate to dryness under an infrared lamp.

7. Add 20 ml of conc HNO_3 and then add 20 mls perchloric acid. Reflux gently on a hotplate until the solution has turned pale straw to water-white in color.

8. Evaporate to dryness under an infrared lamp.

9. Dissolve in 50 mls 8 M HCl and 50 mls DI water, warm on hotplate if necessary. Allow to cool.

10. Co-precipitate the U, Th, and Fe with conc ammonia added dropwise. Transfer solution to 50 ml PP centrifuge tubes, centrifuge and discard supernate. Wash with 0.05 M ammonia, centrifuge and discard washings. Precipitate is now ready for U/Th ion exchange separation.

(IV) CR *Crystalline iron oxides*

1. Cool and record weight of dried residue in tube.

   Weight = ________ g

2. Add 30 ml of Coffin's reagent to the residue in the tube. Add 1.5 g (5%) of sodium dithionite ($Na_2S_2O_4$) and shake for 1 hr on wrist shaker.

3. Centifuge at10,000 rpm for 10 min. Transfer supernate to PP bottle and label as 'CR' fraction.

4. Re-extract with fresh solution if residue is not completely free of Fe (residue should be white or gray). Centrifuge at 10,000 rpm for 10 min, and add supernate to PP bottle. Add 30 mls ultrapure water to residue, homogenize, centrifuge, and add supernate to PP bottle.

   Place tube with residue in drying oven overnight.

5. Add $^{232}U/^{228}Th$ spike to supernate and record spike weight.

   Spike # ________
   Reference Activity ________pCi/g
   Reference Date ________
   Spike weight ________ g

   Allow to equilibrate overnight.

6. Transfer half of solution into a large teflon beaker. Evaporate to dryness under an infrared lamp. (A crystalline crust will form and it may be necessary to break it up with a stirring rod to assist drying-out.)

7. Add conc nitric acid drop-by-drop until effervescence ceases. (Be careful, reaction can be quite violent.)

8. Evaporate to dryness under an infrared lamp.

9. Add 20 ml of conc HNO_3 and then add 20 mls perchloric acid. Reflux gently on a hotplate until the solution has turned pale straw to water-white in color.

10. Evaporate to dryness under an infrared lamp.

11. Repeat steps 9-10.

12. Dissolve in 50 mls 8 M HCl and 50 mls DI water, warm on hotplate if necessary. Allow to cool.

13. Co-precipitate the U, Th, and Fe with conc ammonia added dropwise. Transfer solution to 50 ml PP centrifuge tubes, centrifuge and discard supernate. Wash with 0.05 M ammonia, centrifuge and discard washings. Precipitate is now ready for U/Th ion exchange separation.

(V) R *Resistate (primary minerals and clays)*

1. Cool and record weight of dried residue in tube.

   Weight = __________ g

2. Transfer residue to a teflon PFA vessel for microwave digestion.

3. Using a weighing boat, quantitatively add a known amount of $^{232}U/^{228}Th$ spike to the PFA vessel.

   $^{232}U/^{228}Th$ spike # ________ Reference Date _________

   Reference Activity ________pCi/g Spike wt. ________g

3. Add reagents to vessel and record volumes:

Reagents	Volume (ml)
____________	____________
____________	____________
____________	____________
____________	____________

4. Seal vessel, place on turntable in microwave, enter and run digestion program. Cool and vent vessel. If sample is not completely dissolved repeat step 4 .

5. Quantitatively transfer sample to a clean teflon beaker, washing the PFA vessel several times with ultrapure water.

6. Split sample into two parts: half is saved in a PP bottle for later processing if necessary and the other half is analyzed for U and Th isotopes.

7. Add 1 ml of perchloric acid ($HCLO_4$) to the sample solution in the teflon beaker. Evaporate to fumes of $HCLO_4$. Pick up in a small amount (~2 ml) of conc. HCl and dilute to approximately 2M (total ~10 ml).

8. Transfer solution to a 50 ml PP centrifuge tube. Add 0.5 ml Fe carrier and coprecipitate actinides by addition of NH_4OH to pH = 7.
   **Note: if sample already contains significant Fe, then Fe carrier does not need to be added.

9. Separate the Fe scavange by centrifugation and decant. Wash the precipitate with ultrapure water, centrifuge, and decant. Repeat washing. Precipitate is ready for ion-exchange separation.

Ion Exchange Separation - all precipitates

Dissovle the precipitates in ~3 ml conc HCl. Add 1 ml ultrapure water to dilute to ~9M.

Main Column (Biorad 1.5 cm diameter column with 10 cm resin; prewash with 4-5 column vols 9M HCl)

Load sample in 9M HCl and allow to drain	___			
Wash 3 volumes (~35 ml) 9M HCl --> Th	___	___	___	
Elute 4 volumes (~50 ml) 0.1M HCl --> U and Fe	___	___	___	___

Separation Date ______________

***Note: May work on U and Th fractions simultaneously from this point on.

Thorium Column (Biorad 0.7 cm diameter column with 10 cm resin; prewash with 4-5 column vols 8M HNO_3)

Heat Th fraction to evaporate HCl	___			
Add ~5 ml conc HNO_3 to dissolve residue	___			
Add equal vol (~5 ml) DI water so soln 8M HNO_3	___			
Load onto column in 8M HNO_3	___			
Wash 3-4 column vols 8M HNO_3	___	___	___	
Elute 4-5 column vols 9M HCl --> Th	___	___	___	___

Uranium Column (Biorad 0.7 cm diameter column with 10 cm resin; prewash with 4-5 column vols 8M HNO_3)

Evaoprate U fraction to near dryness	___			
Pick up in about 2 ml conc HNO_3	___			
Dilute with about 2 ml DI water to approx 8M HNO_3	___			
Load onto column in 8M HNO_3	___			
Wash 2 vols (8-10 ml) 8M HNO_3 --> Fe	___	___		
Elute 4-5 vols 0.1M HCl --> U	___	___	___	___

Source Preparation:

Thorium - OH^- precipitation onto filter

1. Evaporate solution containing Th to near dryness.
2. Add 6 ml 0.05 M EDTA soln to dissolve residue, transfer soln to a 50 ml PP centrifuge tube and place tube in boiling water for a few minutes.
3. Add 100 µl purified cerous nitrate (0.5 mg/ml Ce) to precipitate hydroxides. Mix, add 2 drops 25% hydrazine dihydrochloride, and 2 ml of 10M NaOH.
4. Place tube in boiling water bath for 10 minutes, remove, and place tube in cold water for 10 minutes to ensure complete precipitation
5. Wet a 25 mm membrane filter with 80% ethanol and place in a 50 ml polysulfone filter funnel.
6. Shake bottle of substrate suspension (ceric hydroxide containing 10 µg Ce/ml) vigorously and draw 2 consecutive 5 ml portions through the filter with full suction. Allow each portion to suck dry for 10-15 sec.
7. Without interrupting suction, pour the sample into the filter chimney and allow to suck dry.
8. While the sample is still filtering, add 0.5 ml 10M NaOH to the sample tube and about 5 ml ultrapure water down the sides of the tube. After the sample has sucked dry, swirl the wash solution around the sides and add it to the filter chimney.
9. Wash tube, filter chimney, precipitate, and filter with three consecutive 5 ml portions of 80% ethanol.
10. Suck filter dry for about 15 sec and remove the chimney and filter carefully without interrupting the suction. Transfer filter to a plastic container and at low temperature (~60C).
11. Glue to tape the dry filter onto a 1 inch stainless steel planchet and count.

Th Counting Date______________

Uranium - F^- precipitation onto filter

1. To the solution containing U, add 1 ml of 10% sodium hydrogen sulfate and 100 µl puriified cerous nitrate (0.5 mg/ml Ce, 50 µg of Ce carrier) and evaporate the solution until completely dry and no more fumes are given off.
2. Add 2 ml of 1M HCl to the beaker containing the purified U fraction and heat gently to dissolve the sodium hydrogen sulfate cake and any possible insoluble double salts with the Ce carrier.
3. Transfer solution to a 50 ml polycarbonate centrifuge tube with two more 2 ml portions of 1M HCl.
4. Add 2 drops of 20% titanium trichloride which should produce a strong violet color. If not, iron is probably present and a few more drops of titanium trichloride must be added to produce a permanent violet color or reduction and precipitation of U will be incomplete.
5. Add 0.5 ml (10 drops) of 48% HF. The violet color dissappears and any slight turbidity should clear up.
6. Mix thoroughly and allow solution to stand for 30 min in a cold water bath to obtain complete precipitation of cerous and uranous fluorides.
7. Place the tube in an ultrasonic bath for 1 min to disperse the precipitate.
8. Mount the precipitate on a 25 mm membrane filter previously treated with two 5 ml portions of cerous fluoride substrate as described above.
9. After sucking the precipitate dry, wash with 5 ml of water containing 2 drops of 48% HF and then with 80% ethanol.
10. Dry and analyze as described above.

U Counting Date______________

Procedure: The extraction, separation, and source preparation procedures shown below are used to process samples.

Sample ID # ________________
Date ________________

Sequential phase extractions

(I) IE *Readily ion-exchangeable*

1. Weigh 1-3 g powdered sample into a 50 ml PP centrifuge tube.

   Sample weight = ________ g
   Sample weight + tube = ________g

   Add 50 ml of 1 M $MgCl_2$ at pH 7 and shake for 1 hour on wrist shaker.

2. Centrifuge at 10,000 rpm for 10 min; transfer supernate to PP bottle and label as 'IE' fraction. Add 30 ml ultrapure water to tube; homogenize; centrifuge at 10,000 rpm for 10 min and add supernate to PP bottle.

   Place tube with residue in drying oven overnight.

3. Add $^{232}U/^{228}Th$ spike to supernate and record spike weight.

   Spike # ________
   Reference Activity ________pCi/g
   Reference Date ________
   Spike weight ________ g

   Add 0.5 mls Fe carrier and allow to equilibrate overnight.

4. Transfer half of solution into a 50 ml PP centrifuge tube. Add 2 mls conc HCl and mix; add ammonia solution gradually, stirring after each addition until Fe-hydroxide precipiates (red-brown).

   Note: Take care not to add too much ammonia or the Mg will precipitate too, producing a thick white precipitate. If this does happen re-dissolve in HCl and repeat precipitation.

5. Centrifuge and discard supernate. Wash with 0.05 M ammonia, centrifuge and discard washings. Precipitate is now ready for U/Th ion exchange separation.

(II). Ad Adsorbed

1. Cool and record weight of dried residue in tube.

   Weight = _________ g

2. Add 30 ml of Morgan's reagent and 2.0 ml 0.3 M EDTA to the residue in the tube. Shake for at least 6 hrs on wrist shaker.

3. Centifuge at 10,000 rpm for 10 min. Transfer supernate to PP bottle and label as 'AD' fraction. Add 30 mls ultrapure water, homogenize, centrifuge at 10,000 rpm for 10 min, and add supernate to PP bottle.

   Place tube with residue in drying oven overnight.

4. Add $^{232}U/^{228}Th$ spike to supernate and record spike weight.

   Spike # _______ Reference Date _________
   Reference Activity _________pCi/g Spike weight _________ g

   Add 0.5 ml Fe carrier to supernate and allow to equilibrate overnight.

5. Transfer half of solution into a large teflon beaker. Evaporate to dryness under an infrared lamp.

6. Add 20 ml of conc HNO_3 and then add 20 mls perchloric acid. Reflux gently on a hotplate until the solution has turned pale straw to water-white in color.

7. Evaporate to dryness under an infrared lamp.

8. Dissolve in 50 mls 8 M HCl and 50 mls DI water, warm on hotplate if necessary. Allow to cool.

9. Co-precipitate the U, Th, and Fe with conc ammonia added dropwise. Transfer solution to 50 ml PP centrifuge tubes, centrifuge and discard supernate. Wash with 0.05 M ammonia, centrifuge and discard washings. Precipitate is now ready for U/Th ion exchange separation.

(III) AM *Amorphous iron oxides*

1. Cool and record weight of dried residue in tube.

   Weight = __________ g

2. Add 50 ml of Tamm's acid oxalate reagent to the residue in the tube. Shake for 4 hrs on wrist shaker in the dark. Check after the 1st hour and carefully release any built up pressure.

3. Centifuge quickly at 10,000 rpm for 10 min; minimize exposure to light. Transfer supernate to PP bottle and label as 'AM' fraction. Add a further 30 mls oxalate solution to the residue and shake for a further half hour.

4. Centrifuge at 10,000 rpm for 10 min, and add supernate to PP bottle. Add 30 mls ultrapure water to residue, homogenize, centrifuge, and add supernate to PP bottle.

   Place tube with residue in drying oven overnight.

5. Add $^{232}U/^{228}Th$ spike to supernate and record spike weight.

   Spike # ________ Reference Date _________
   Reference Activity _________pCi/g Spike weight _________ g

   Allow to equilibrate overnight.

6. Transfer half of solution into a large teflon beaker. Evaporate to dryness under an infrared lamp.

7. Add 20 ml of conc HNO_3 and then add 20 mls perchloric acid. Reflux gently on a hotplate until the solution has turned pale straw to water-white in color.

8. Evaporate to dryness under an infrared lamp.

9. Dissolve in 50 mls 8 M HCl and 50 mls DI water, warm on hotplate if necessary. Allow to cool.

10. Co-precipitate the U, Th, and Fe with conc ammonia added dropwise. Transfer solution to 50 ml PP centrifuge tubes, centrifuge and discard supernate. Wash with 0.05 M ammonia, centrifuge and discard washings. Precipitate is now ready for U/Th ion exchange separation.

(IV) CR *Crystalline iron oxides*

1. Cool and record weight of dried residue in tube.

   Weight = __________ g

2. Add 30 ml of Coffin's reagent to the residue in the tube. Add 1.5 g (5%) of sodium dithionite ($Na_2S_2O_4$) and shake for 1 hr on wrist shaker.

3. Centifuge at10,000 rpm for 10 min. Transfer supernate to PP bottle and label as 'CR' fraction.

4. Re-extract with fresh solution if residue is not completely free of Fe (residue should be white or gray). Centrifuge at 10,000 rpm for 10 min, and add supernate to PP bottle. Add 30 mls ultrapure water to residue, homogenize, centrifuge, and add supernate to PP bottle.

   Place tube with residue in drying oven overnight.

5. Add $^{232}U/^{228}Th$ spike to supernate and record spike weight.

   Spike # ________ Reference Date _________
   Reference Activity _________pCi/g Spike weight _________ g

   Allow to equilibrate overnight.

6. Transfer half of solution into a large teflon beaker. Evaporate to dryness under an infrared lamp. (A crystalline crust will form and it may be necessary to break it up with a stirring rod to assist drying-out.)

7. Add conc nitric acid drop-by-drop until effervescence ceases. (Be careful, reaction can be quite violent.)

8. Evaporate to dryness under an infrared lamp.

9. Add 20 ml of conc HNO_3 and then add 20 mls perchloric acid. Reflux gently on a hotplate until the solution has turned pale straw to water-white in color.

10. Evaporate to dryness under an infrared lamp.

11. Repeat steps 9-10.

12. Dissolve in 50 mls 8 M HCl and 50 mls DI water, warm on hotplate if necessary. Allow to cool.

13. Co-precipitate the U, Th, and Fe with conc ammonia added dropwise. Transfer solution to 50 ml PP centrifuge tubes, centrifuge and discard supernate. Wash with 0.05 M ammonia, centrifuge and discard washings. Precipitate is now ready for U/Th ion exchange separation.

(V) R *Resistate (primary minerals and clays)*

1. Cool and record weight of dried residue in tube.

   Weight = __________ g

2. Transfer residue to a teflon PFA vessel for microwave digestion.

3. Using a weighing boat, quantitatively add a known amount of $^{232}U/^{228}Th$ spike to the PFA vessel.

   $^{232}U/^{228}Th$ spike # ________ Reference Date _________

   Reference Activity ________pCi/g Spike wt. ________g

3. Add reagents to vessel and record volumes:

Reagents	Volume (ml)
____________	____________
____________	____________
____________	____________
____________	____________

4. Seal vessel, place on turntable in microwave, enter and run digestion program. Cool and vent vessel. If sample is not completely dissolved repeat step 4 .

5. Quantitatively transfer sample to a clean teflon beaker, washing the PFA vessel several times with ultrapure water.

6. Split sample into two parts: half is saved in a PP bottle for later processing if necessary and the other half is analyzed for U and Th isotopes.

7. Add 1 ml of perchloric acid ($HClO_4$) to the sample solution in the teflon beaker. Evaporate to fumes of $HClO_4$. Pick up in a small amount (~2 ml) of conc. HCl and dilute to approximately 2M (total ~10 ml).

8. Transfer solution to a 50 ml PP centrifuge tube. Add 0.5 ml Fe carrier and coprecipitate actinides by addition of NH_4OH to pH = 7.
   **Note: if sample already contains significant Fe, then Fe carrier does not need to be added.

9. Separate the Fe scavange by centrifugation and decant. Wash the precipitate with ultrapure water, centrifuge, and decant. Repeat washing. Precipitate is ready for ion-exchange separation.

Ion Exchange Separation - all precipitates

Dissovle the precipitates in ~3 ml conc HCl. Add 1 ml ultrapure water to dilute to ~9M.

Main Column (Biorad 1.5 cm diameter column with 10 cm resin; prewash with 4-5 column vols 9M HCl)

Load sample in 9M HCl and allow to drain	___			
Wash 3 volumes (~35 ml) 9M HCl --> Th	___	___	___	
Elute 4 volumes (~50 ml) 0.1M HCl --> U and Fe	___	___	___	___

Separation Date ______________

***Note: May work on U and Th fractions simultaneously from this point on.

Thorium Column (Biorad 0.7 cm diameter column with 10 cm resin; prewash with 4-5 column vols 8M HNO_3)

Heat Th fraction to evaporate HCl	___			
Add ~5 ml conc HNO_3 to dissolve residue	___			
Add equal vol (~5 ml) DI water so soln 8M HNO_3	___			
Load onto column in 8M HNO_3	___			
Wash 3-4 column vols 8M HNO_3	___	___	___	
Elute 4-5 column vols 9M HCl --> Th	___	___	___	___

Uranium Column (Biorad 0.7 cm diameter column with 10 cm resin; prewash with 4-5 column vols 8M HNO_3)

Evaoprate U fraction to near dryness	___			
Pick up in about 2 ml conc HNO_3	___			
Dilute with about 2 ml DI water to approx 8M HNO_3	___			
Load onto column in 8M HNO_3	___			
Wash 2 vols (8-10 ml) 8M HNO_3 --> Fe	___	___		
Elute 4-5 vols 0.1M HCl --> U	___	___	___	___

Source Preparation:

Thorium - OH^- precipitation onto filter

1. Evaporate solution containing Th to near dryness.
2. Add 6 ml 0.05 M EDTA soln to dissolve residue, transfer soln to a 50 ml PP centrifuge tube and place tube in boiling water for a few minutes.
3. Add 100 µl purified cerous nitrate (0.5 mg/ml Ce) to precipitate hydroxides. Mix, add 2 drops 25% hydrazine dihydrochloride, and 2 ml of 10M NaOH.
4. Place tube in boiling water bath for 10 minutes, remove, and place tube in cold water for 10 minutes to ensure complete precipitation
5. Wet a 25 mm membrane filter with 80% ethanol and place in a 50 ml polysulfone filter funnel.
6. Shake bottle of substrate suspension (ceric hydroxide containing 10 µg Ce/ml) vigorously and draw 2 consecutive 5 ml portions through the filter with full suction. Allow each portion to suck dry for 10-15 sec.
7. Without interrupting suction, pour the sample into the filter chimney and allow to suck dry.
8. While the sample is still filtering, add 0.5 ml 10M NaOH to the sample tube and about 5 ml ultrapure water down the sides of the tube. After the sample has sucked dry, swirl the wash solution around the sides and add it to the filter chimney.
9. Wash tube, filter chimney, precipitate, and filter with three consecutive 5 ml portions of 80% ethanol.
10. Suck filter dry for about 15 sec and remove the chimney and filter carefully without interrupting the suction. Transfer filter to a plastic container and at low temperature (~60C).
11. Glue to tape the dry filter onto a 1 inch stainless steel planchet and count.

Th Counting Date______________

Uranium - F^- precipitation onto filter

1. To the solution containing U, add 1 ml of 10% sodium hydrogen sulfate and 100 µl puriified cerous nitrate (0.5 mg/ml Ce, 50 µg of Ce carrier) and evaporate the solution until completely dry and no more fumes are given off.
2. Add 2 ml of 1M HCl to the beaker containing the purified U fraction and heat gently to dissolve the sodium hydrogen sulfate cake and any possible insoluble double salts with the Ce carrier.
3. Transfer solution to a 50 ml polycarbonate centrifuge tube with two more 2 ml portions of 1M HCl.
4. Add 2 drops of 20% titanium trichloride which should produce a strong violet color. If not, iron is probably present and a few more drops of titanium trichloride must be added to produce a permanent violet color or reduction and precipitation of U will be incomplete.
5. Add 0.5 ml (10 drops) of 48% HF. The violet color dissappears and any slight turbidity should clear up.
6. Mix thoroughly and allow solution to stand for 30 min in a cold water bath to obtain complete precipitation of cerous and uranous fluorides.
7. Place the tube in an ultrasonic bath for 1 min to disperse the precipitate.
8. Mount the precipitate on a 25 mm membrane filter previously treated with two 5 ml portions of cerous fluoride substrate as described above.
9. After sucking the precipitate dry, wash with 5 ml of water containing 2 drops of 48% HF and then with 80% ethanol.
10. Dry and analyze as described above.

U Counting Date______________

Procedure: The extraction, separation, and source preparation procedures shown below are used to process samples.

Sample ID # ________________
Date ________________

Sequential phase extractions

(I) IE *Readily ion-exchangeable*

1. Weigh 1-3 g powdered sample into a 50 ml PP centrifuge tube.

   Sample weight = _________ g
   Sample weight + tube = __________g

   Add 50 ml of 1 M $MgCl_2$ at pH 7 and shake for 1 hour on wrist shaker.

2. Centrifuge at 10,000 rpm for 10 min; transfer supernate to PP bottle and label as 'IE' fraction. Add 30 ml ultrapure water to tube; homogenize; centrifuge at 10,000 rpm for 10 min and add supernate to PP bottle.

   Place tube with residue in drying oven overnight.

3. Add $^{232}U/^{228}Th$ spike to supernate and record spike weight.

   Spike # ________ Reference Date _________
   Reference Activity _________pCi/g Spike weight _________ g

   Add 0.5 mls Fe carrier and allow to equilibrate overnight.

4. Transfer half of solution into a 50 ml PP centrifuge tube. Add 2 mls conc HCl and mix; add ammonia solution gradually, stirring after each addition until Fe-hydroxide precipiates (red-brown).

   Note: Take care not to add too much ammonia or the Mg will precipitate too, producing a thick white precipitate. If this does happen re-dissolve in HCl and repeat precipitation.

5. Centrifuge and discard supernate. Wash with 0.05 M ammonia, centrifuge and discard washings. Precipitate is now ready for U/Th ion exchange separation.

(II). Ad *Adsorbed*

1. Cool and record weight of dried residue in tube.

   Weight = __________ g

2. Add 30 ml of Morgan's reagent and 2.0 ml 0.3 M EDTA to the residue in the tube. Shake for at least 6 hrs on wrist shaker.

3. Centifuge at 10,000 rpm for 10 min. Transfer supernate to PP bottle and label as 'AD' fraction. Add 30 mls ultrapure water, homogenize, centrifuge at 10,000 rpm for 10 min, and add supernate to PP bottle.

   Place tube with residue in drying oven overnight.

4. Add $^{232}U/^{228}Th$ spike to supernate and record spike weight.

   Spike # ________ Reference Date ________
   Reference Activity ________pCi/g Spike weight ________ g

   Add 0.5 ml Fe carrier to supernate and allow to equilibrate overnight.

5. Transfer half of solution into a large teflon beaker. Evaporate to dryness under an infrared lamp.

6. Add 20 ml of conc HNO_3 and then add 20 mls perchloric acid. Reflux gently on a hotplate until the solution has turned pale straw to water-white in color.

7. Evaporate to dryness under an infrared lamp.

8. Dissolve in 50 mls 8 M HCl and 50 mls DI water, warm on hotplate if necessary. Allow to cool.

9. Co-precipitate the U, Th, and Fe with conc ammonia added dropwise. Transfer solution to 50 ml PP centrifuge tubes, centrifuge and discard supernate. Wash with 0.05 M ammonia, centrifuge and discard washings. Precipitate is now ready for U/Th ion exchange separation.

(III) AM *Amorphous iron oxides*

1. Cool and record weight of dried residue in tube.

   Weight = __________ g

2. Add 50 ml of Tamm's acid oxalate reagent to the residue in the tube. Shake for 4 hrs on wrist shaker in the dark. Check after the 1st hour and carefully release any built up pressure.

3. Centifuge quickly at 10,000 rpm for 10 min; minimize exposure to light. Transfer supernate to PP bottle and label as 'AM' fraction. Add a further 30 mls oxalate solution to the residue and shake for a further half hour.

4. Centrifuge at 10,000 rpm for 10 min, and add supernate to PP bottle. Add 30 mls ultrapure water to residue, homogenize, centrifuge, and add supernate to PP bottle.

   Place tube with residue in drying oven overnight.

5. Add $^{232}U/^{228}Th$ spike to supernate and record spike weight.

   Spike # ________ Reference Date _________
   Reference Activity _________pCi/g Spike weight _________ g

   Allow to equilibrate overnight.

6. Transfer half of solution into a large teflon beaker. Evaporate to dryness under an infrared lamp.

7. Add 20 ml of conc HNO_3 and then add 20 mls perchloric acid. Reflux gently on a hotplate until the solution has turned pale straw to water-white in color.

8. Evaporate to dryness under an infrared lamp.

9. Dissolve in 50 mls 8 M HCl and 50 mls DI water, warm on hotplate if necessary. Allow to cool.

10. Co-precipitate the U, Th, and Fe with conc ammonia added dropwise. Transfer solution to 50 ml PP centrifuge tubes, centrifuge and discard supernate. Wash with 0.05 M ammonia, centrifuge and discard washings. Precipitate is now ready for U/Th ion exchange separation.

(IV) CR *Crystalline iron oxides*

1. Cool and record weight of dried residue in tube.

   Weight = __________ g

2. Add 30 ml of Coffin's reagent to the residue in the tube. Add 1.5 g (5%) of sodium dithionite ($Na_2S_2O_4$) and shake for 1 hr on wrist shaker.

3. Centifuge at10,000 rpm for 10 min. Transfer supernate to PP bottle and label as 'CR' fraction.

4. Re-extract with fresh solution if residue is not completely free of Fe (residue should be white or gray). Centrifuge at 10,000 rpm for 10 min, and add supernate to PP bottle. Add 30 mls ultrapure water to residue, homogenize, centrifuge, and add supernate to PP bottle.

   Place tube with residue in drying oven overnight.

5. Add $^{232}U/^{228}Th$ spike to supernate and record spike weight.

   Spike # ________ Reference Date _________
   Reference Activity _________pCi/g Spike weight _________ g

   Allow to equilibrate overnight.

6. Transfer half of solution into a large teflon beaker. Evaporate to dryness under an infrared lamp. (A crystalline crust will form and it may be necessary to break it up with a stirring rod to assist drying-out.)

7. Add conc nitric acid drop-by-drop until effervescence ceases. (Be careful, reaction can be quite violent.)

8. Evaporate to dryness under an infrared lamp.

9. Add 20 ml of conc HNO_3 and then add 20 mls perchloric acid. Reflux gently on a hotplate until the solution has turned pale straw to water-white in color.

10. Evaporate to dryness under an infrared lamp.

11. Repeat steps 9-10.

12. Dissolve in 50 mls 8 M HCl and 50 mls DI water, warm on hotplate if necessary. Allow to cool.

13. Co-precipitate the U, Th, and Fe with conc ammonia added dropwise. Transfer solution to 50 ml PP centrifuge tubes, centrifuge and discard supernate. Wash with 0.05 M ammonia, centrifuge and discard washings. Precipitate is now ready for U/Th ion exchange separation.

(V) R *Resistate (primary minerals and clays)*

1. Cool and record weight of dried residue in tube.

   Weight = __________ g

2. Transfer residue to a teflon PFA vessel for microwave digestion.

3. Using a weighing boat, quantitatively add a known amount of $^{232}U/^{228}Th$ spike to the PFA vessel.

   $^{232}U/^{228}Th$ spike # ________ Reference Date ________

   Reference Activity ________pCi/g Spike wt. ________g

3. Add reagents to vessel and record volumes:

Reagents	Volume (ml)
____________	____________
____________	____________
____________	____________
____________	____________

4. Seal vessel, place on turntable in microwave, enter and run digestion program. Cool and vent vessel. If sample is not completely dissolved repeat step 4 .

5. Quantitatively transfer sample to a clean teflon beaker, washing the PFA vessel several times with ultrapure water.

6. Split sample into two parts: half is saved in a PP bottle for later processing if necessary and the other half is analyzed for U and Th isotopes.

7. Add 1 ml of perchloric acid ($HClO_4$) to the sample solution in the teflon beaker. Evaporate to fumes of $HClO_4$. Pick up in a small amount (~2 ml) of conc. HCl and dilute to approximately 2M (total ~10 ml).

8. Transfer solution to a 50 ml PP centrifuge tube. Add 0.5 ml Fe carrier and coprecipitate actinides by addition of NH_4OH to pH = 7.

   **Note: if sample already contains significant Fe, then Fe carrier does not need to be added.

9. Separate the Fe scav .nge by centrifugation and decant. Wash the precipitate with ultrapure water, centrifuge, ar ɟ decant. Repeat washing. Precipitate is ready for ion-exchange separation.

Ion Exchange Separation - all precipitates

Dissovle the precipitates in ~3 ml conc HCl. Add 1 ml ultrapure water to dilute to ~9M.

<u>Main Column</u> (Biorad 1.5 cm diameter column with 10 cm resin; prewash with 4-5 column vols 9M HCl)

Load sample in 9M HCl and allow to drain	___			
Wash 3 volumes (~35 ml) 9M HCl --> <u>Th</u>	___	___	___	
Elute 4 volumes (~50 ml) 0.1M HCl --> <u>U and Fe</u>	___	___	___	___

Separation Date ______________

***Note: May work on U and Th fractions simultaneously from this point on.

<u>Thorium Column</u> (Biorad 0.7 cm diameter column with 10 cm resin; prewash with 4-5 column vols 8M HNO_3)

Heat Th fraction to evaporate HCl	___			
Add ~5 ml conc HNO_3 to dissolve residue	___			
Add equal vol (~5 ml) DI water so soln 8M HNO_3	___			
Load onto column in 8M HNO_3	___			
Wash 3-4 column vols 8M HNO_3	___	___	___	
Elute 4-5 column vols 9M HCl --> <u>Th</u>	___	___	___	___

<u>Uranium Column</u> (Biorad 0.7 cm diameter column with 10 cm resin; prewash with 4-5 column vols 8M HNO_3)

Evaoprate U fraction to near dryness	___			
Pick up in about 2 ml conc HNO_3	___			
Dilute with about 2 ml DI water to approx 8M HNO_3	___			
Load onto column in 8M HNO_3	___			
Wash 2 vols (8-10 ml) 8M HNO_3 --> Fe	___	___		
Elute 4-5 vols 0.1M HCl --> <u>U</u>	___	___	___	___

Source Preparation:

Thorium - OH^- precipitation onto filter

1. Evaporate solution containing Th to near dryness.
2. Add 6 ml 0.05 M EDTA soln to dissolve residue, transfer soln to a 50 ml PP centrifuge tube and place tube in boiling water for a few minutes.
3. Add 100 µl purified cerous nitrate (0.5 mg/ml Ce) to precipitate hydroxides. Mix, add 2 drops 25% hydrazine dihydrochloride, and 2 ml of 10M NaOH.
4. Place tube in boiling water bath for 10 minutes, remove, and place tube in cold water for 10 minutes to ensure complete precipitation
5. Wet a 25 mm membrane filter with 80% ethanol and place in a 50 ml polysulfone filter funnel.
6. Shake bottle of substrate suspension (ceric hydroxide containing 10 µg Ce/ml) vigorously and draw 2 consecutive 5 ml portions through the filter with full suction. Allow each portion to suck dry for 10-15 sec.
7. Without interrupting suction, pour the sample into the filter chimney and allow to suck dry.
8. While the sample is still filtering, add 0.5 ml 10M NaOH to the sample tube and about 5 ml ultrapure water down the sides of the tube. After the sample has sucked dry, swirl the wash solution around the sides and add it to the filter chimney.
9. Wash tube, filter chimney, precipitate, and filter with three consecutive 5 ml portions of 80% ethanol.
10. Suck filter dry for about 15 sec and remove the chimney and filter carefully without interrupting the suction. Transfer filter to a plastic container and at low temperature (~60C).
11. Glue to tape the dry filter onto a 1 inch stainless steel planchet and count.

Th Counting Date______________

Uranium - F^- precipitation onto filter

1. To the solution containing U, add 1 ml of 10% sodium hydrogen sulfate and 100 µl puriified cerous nitrate (0.5 mg/ml Ce, 50 µg of Ce carrier) and evaporate the solution until completely dry and no more fumes are given off.
2. Add 2 ml of 1M HCl to the beaker containing the purified U fraction and heat gently to dissolve the sodium hydrogen sulfate cake and any possible insoluble double salts with the Ce carrier.
3. Transfer solution to a 50 ml polycarbonate centrifuge tube with two more 2 ml portions of 1M HCl.
4. Add 2 drops of 20% titanium trichloride which should produce a strong violet color. If not, iron is probably present and a few more drops of titanium trichloride must be added to produce a permanent violet color or reduction and precipitation of U will be incomplete.
5. Add 0.5 ml (10 drops) of 48% HF. The violet color dissappears and any slight turbidity should clear up.
6. Mix thoroughly and allow solution to stand for 30 min in a cold water bath to obtain complete precipitation of cerous and uranous fluorides.
7. Place the tube in an ultrasonic bath for 1 min to disperse the precipitate.
8. Mount the precipitate on a 25 mm membrane filter previously treated with two 5 ml portions of cerous fluoride substrate as described above.
9. After sucking the precipitate dry, wash with 5 ml of water containing 2 drops of 48% HF and then with 80% ethanol.
10. Dry and analyze as described above.

U Counting Date______________

Procedure: The extraction, separation, and source preparation procedures shown below are used to process samples.

Sample ID # ________________
Date ________________

Sequential phase extractions

(I) IE *Readily ion-exchangeable*

1. Weigh 1-3 g powdered sample into a 50 ml PP centrifuge tube.

   Sample weight = ________ g
   Sample weight + tube = ________g

   Add 50 ml of 1 M $MgCl_2$ at pH 7 and shake for 1 hour on wrist shaker.

2. Centrifuge at 10,000 rpm for 10 min; transfer supernate to PP bottle and label as 'IE' fraction. Add 30 ml ultrapure water to tube; homogenize; centrifuge at 10,000 rpm for 10 min and add supernate to PP bottle.

   Place tube with residue in drying oven overnight.

3. Add $^{232}U/^{228}Th$ spike to supernate and record spike weight.

   Spike # ________ Reference Date ________
   Reference Activity ________pCi/g Spike weight ________ g

   Add 0.5 mls Fe carrier and allow to equilibrate overnight.

4. Transfer half of solution into a 50 ml PP centrifuge tube. Add 2 mls conc HCl and mix; add ammonia solution gradually, stirring after each addition until Fe-hydroxide precipiates (red-brown).

   Note: Take care not to add too much ammonia or the Mg will precipitate too, producing a thick white precipitate. If this does happen re-dissolve in HCl and repeat precipitation.

5. Centrifuge and discard supernate. Wash with 0.05 M ammonia, centrifuge and discard washings. Precipitate is now ready for U/Th ion exchange separation.

(II). Ad *Adsorbed*

1. Cool and record weight of dried residue in tube.

   Weight = __________ g

2. Add 30 ml of Morgan's reagent and 2.0 ml 0.3 M EDTA to the residue in the tube. Shake for at least 6 hrs on wrist shaker.

3. Centifuge at 10,000 rpm for 10 min. Transfer supernate to PP bottle and label as 'AD' fraction. Add 30 mls ultrapure water, homogenize, centrifuge at 10,000 rpm for 10 min, and add supernate to PP bottle.

   Place tube with residue in drying oven overnight.

4. Add $^{232}U/^{228}Th$ spike to supernate and record spike weight.

   Spike # ________ Reference Date ________
   Reference Activity ________pCi/g Spike weight ________ g

   Add 0.5 ml Fe carrier to supernate and allow to equilibrate overnight.

5. Transfer half of solution into a large teflon beaker. Evaporate to dryness under an infrared lamp.

6. Add 20 ml of conc HNO_3 and then add 20 mls perchloric acid. Reflux gently on a hotplate until the solution has turned pale straw to water-white in color.

7. Evaporate to dryness under an infrared lamp.

8. Dissolve in 50 mls 8 M HCl and 50 mls DI water, warm on hotplate if necessary. Allow to cool.

9. Co-precipitate the U, Th, and Fe with conc ammonia added dropwise. Transfer solution to 50 ml PP centrifuge tubes, centrifuge and discard supernate. Wash with 0.05 M ammonia, centrifuge and discard washings. Precipitate is now ready for U/Th ion exchange separation.

(III) AM *Amorphous iron oxides*

1. Cool and record weight of dried residue in tube.

   Weight = ________ g

2. Add 50 ml of Tamm's acid oxalate reagent to the residue in the tube. Shake for 4 hrs on wrist shaker in the dark. Check after the 1st hour and carefully release any built up pressure.

3. Centifuge quickly at 10,000 rpm for 10 min; minimize exposure to light. Transfer supernate to PP bottle and label as 'AM' fraction. Add a further 30 mls oxalate solution to the residue and shake for a further half hour.

4. Centrifuge at 10,000 rpm for 10 min, and add supernate to PP bottle. Add 30 mls ultrapure water to residue, homogenize, centrifuge, and add supernate to PP bottle.

   Place tube with residue in drying oven overnight.

5. Add $^{232}U/^{228}Th$ spike to supernate and record spike weight.

   Spike # ________ Reference Date ________
   Reference Activity ________pCi/g Spike weight ________ g

   Allow to equilibrate overnight.

6. Transfer half of solution into a large teflon beaker. Evaporate to dryness under an infrared lamp.

7. Add 20 ml of conc HNO_3 and then add 20 mls perchloric acid. Reflux gently on a hotplate until the solution has turned pale straw to water-white in color.

8. Evaporate to dryness under an infrared lamp.

9. Dissolve in 50 mls 8 M HCl and 50 mls DI water, warm on hotplate if necessary. Allow to cool.

10. Co-precipitate the U, Th, and Fe with conc ammonia added dropwise. Transfer solution to 50 ml PP centrifuge tubes, centrifuge and discard supernate. Wash with 0.05 M ammonia, centrifuge and discard washings. Precipitate is now ready for U/Th ion exchange separation.

(IV) CR *Crystalline iron oxides*

1. Cool and record weight of dried residue in tube.

   Weight = __________ g

2. Add 30 ml of Coffin's reagent to the residue in the tube. Add 1.5 g (5%) of sodium dithionite ($Na_2S_2O_4$) and shake for 1 hr on wrist shaker.

3. Centifuge at10,000 rpm for 10 min. Transfer supernate to PP bottle and label as 'CR' fraction.

4. Re-extract with fresh solution if residue is not completely free of Fe (residue should be white or gray). Centrifuge at 10,000 rpm for 10 min, and add supernate to PP bottle. Add 30 mls ultrapure water to residue, homogenize, centrifuge, and add supernate to PP bottle.

   Place tube with residue in drying oven overnight.

5. Add $^{232}U/^{228}Th$ spike to supernate and record spike weight.

   Spike # ________ Reference Date _________
   Reference Activity _________pCi/g Spike weight _________ g

   Allow to equilibrate overnight.

6. Transfer half of solution into a large teflon beaker. Evaporate to dryness under an infrared lamp. (A crystalline crust will form and it may be necessary to break it up with a stirring rod to assist drying-out.)

7. Add conc nitric acid drop-by-drop until effervescence ceases. (Be careful, reaction can be quite violent.)

8. Evaporate to dryness under an infrared lamp.

9. Add 20 ml of conc HNO_3 and then add 20 mls perchloric acid. Reflux gently on a hotplate until the solution has turned pale straw to water-white in color.

10. Evaporate to dryness under an infrared lamp.

11. Repeat steps 9-10.

12. Dissolve in 50 mls 8 M HCl and 50 mls DI water, warm on hotplate if necessary. Allow to cool.

13. Co-precipitate the U, Th, and Fe with conc ammonia added dropwise. Transfer solution to 50 ml PP centrifuge tubes, centrifuge and discard supernate. Wash with 0.05 M ammonia, centrifuge and discard washings. Precipitate is now ready for U/Th ion exchange separation.

(V) R *Resistate (primary minerals and clays)*

1. Cool and record weight of dried residue in tube.

   Weight = __________ g

2. Transfer residue to a teflon PFA vessel for microwave digestion.

3. Using a weighing boat, quantitatively add a known amount of $^{232}U/^{228}Th$ spike to the PFA vessel.

   $^{232}U/^{228}Th$ spike # ________ Reference Date _________

   Reference Activity ________pCi/g Spike wt. ________g

3. Add reagents to vessel and record volumes:

Reagents	Volume (ml)
____________	____________
____________	____________
____________	____________
____________	____________

4. Seal vessel, place on turntable in microwave, enter and run digestion program. Cool and vent vessel. If sample is not completely dissolved repeat step 4 .

5. Quantitatively transfer sample to a clean teflon beaker, washing the PFA vessel several times with ultrapure water.

6. Split sample into two parts: half is saved in a PP bottle for later processing if necessary and the other half is analyzed for U and Th isotopes.

7. Add 1 ml of perchloric acid ($HCLO_4$) to the sample solution in the teflon beaker. Evaporate to fumes of $HCLO_4$. Pick up in a small amount (~2 ml) of conc. HCl and dilute to approximately 2M (total ~10 ml).

8. Transfer solution to a 50 ml PP centrifuge tube. Add 0.5 ml Fe carrier and coprecipitate actinides by addition of NH_4OH to pH = 7.

   **Note: if sample already contains significant Fe, then Fe carrier does not need to be added.

9. Separate the Fe scavange by centrifugation and decant. Wash the precipitate with ultrapure water, centrifuge, and decant. Repeat washing. Precipitate is ready for ion-exchange separation.

Ion Exchange Separation - all precipitates

Dissovle the precipitates in ~3 ml conc HCl. Add 1 ml ultrapure water to dilute to ~9M.

Main Column (Biorad 1.5 cm diameter column with 10 cm resin; prewash with 4-5 column vols 9M HCl)

Load sample in 9M HCl and allow to drain	___			
Wash 3 volumes (~35 ml) 9M HCl --> Th	___	___	___	
Elute 4 volumes (~50 ml) 0.1M HCl --> U and Fe	___	___	___	___

Separation Date ______________

***Note: May work on U and Th fractions simultaneously from this point on.

Thorium Column (Biorad 0.7 cm diameter column with 10 cm resin; prewash with 4-5 column vols 8M HNO_3)

Heat Th fraction to evaporate HCl	___			
Add ~5 ml conc HNO_3 to dissolve residue	___			
Add equal vol (~5 ml) DI water so soln 8M HNO_3	___			
Load onto column in 8M HNO_3	___			
Wash 3-4 column vols 8M HNO_3	___	___	___	
Elute 4-5 column vols 9M HCl --> Th	___	___	___	___

Uranium Column (Biorad 0.7 cm diameter column with 10 cm resin; prewash with 4-5 column vols 8M HNO_3)

Evaoprate U fraction to near dryness	___			
Pick up in about 2 ml conc HNO_3	___			
Dilute with about 2 ml DI water to approx 8M HNO_3	___			
Load onto column in 8M HNO_3	___			
Wash 2 vols (8-10 ml) 8M HNO_3 --> Fe	___	___		
Elute 4-5 vols 0.1M HCl --> U	___	___	___	___

Source Preparation:

Thorium - OH^- precipitation onto filter

1. Evaporate solution containing Th to near dryness.
2. Add 6 ml 0.05 M EDTA soln to dissolve residue, transfer soln to a 50 ml PP centrifuge tube and place tube in boiling water for a few minutes.
3. Add 100 µl purified cerous nitrate (0.5 mg/ml Ce) to precipitate hydroxides. Mix, add 2 drops 25% hydrazine dihydrochloride, and 2 ml of 10M NaOH.
4. Place tube in boiling water bath for 10 minutes, remove, and place tube in cold water for 10 minutes to ensure complete precipitation
5. Wet a 25 mm membrane filter with 80% ethanol and place in a 50 ml polysulfone filter funnel.
6. Shake bottle of substrate suspension (ceric hydroxide containing 10 µg Ce/ml) vigorously and draw 2 consecutive 5 ml portions through the filter with full suction. Allow each portion to suck dry for 10-15 sec.
7. Without interrupting suction, pour the sample into the filter chimney and allow to suck dry.
8. While the sample is still filtering, add 0.5 ml 10M NaOH to the sample tube and about 5 ml ultrapure water down the sides of the tube. After the sample has sucked dry, swirl the wash solution around the sides and add it to the filter chimney.
9. Wash tube, filter chimney, precipitate, and filter with three consecutive 5 ml portions of 80% ethanol.
10. Suck filter dry for about 15 sec and remove the chimney and filter carefully without interrupting the suction. Transfer filter to a plastic container and at low temperature (~60C).
11. Glue to tape the dry filter onto a 1 inch stainless steel planchet and count.

Th Counting Date______________

Uranium - F^- precipitation onto filter

1. To the solution containing U, add 1 ml of 10% sodium hydrogen sulfate and 100 µl puriified cerous nitrate (0.5 mg/ml Ce, 50 µg of Ce carrier) and evaporate the solution until completely dry and no more fumes are given off.
2. Add 2 ml of 1M HCl to the beaker containing the purified U fraction and heat gently to dissolve the sodium hydrogen sulfate cake and any possible insoluble double salts with the Ce carrier.
3. Transfer solution to a 50 ml polycarbonate centrifuge tube with two more 2 ml portions of 1M HCl.
4. Add 2 drops of 20% titanium trichloride which should produce a strong violet color. If not, iron is probably present and a few more drops of titanium trichloride must be added to produce a permanent violet color or reduction and precipitation of U will be incomplete.
5. Add 0.5 ml (10 drops) of 48% HF. The violet color dissappears and any slight turbidity should clear up.
6. Mix thoroughly and allow solution to stand for 30 min in a cold water bath to obtain complete precipitation of cerous and uranous fluorides.
7. Place the tube in an ultrasonic bath for 1 min to disperse the precipitate.
8. Mount the precipitate on a 25 mm membrane filter previously treated with two 5 ml portions of cerous fluoride substrate as described above.
9. After sucking the precipitate dry, wash with 5 ml of water containing 2 drops of 48% HF and then with 80% ethanol.
10. Dry and analyze as described above.

U Counting Date______________

			Bulk rock		
Sample	Location (m E)	U ppm	Th ppm	234U/238U	230Th/234U
NOPI-417	15.8	3643	17	1.29±0.03	1.27±0.02
NOPI-418	11.7	3529	20	1.28±0.03	1.25±0.02
NOPI-419	9	787	73	1.63±0.04	1.39±0.02
NOPI-420	6.2	1622	36	1.29±0.03	1.31±0.02
NOPI-421	3.3	2506	51	1.18±0.02	1.24±0.02
NOPI-422	1.1	1716	40	1.18±0.03	1.21±0.02
NOPI-423	-2.1	472	28	1.12±0.03	1.31±0.03
NOPI-424	-6.1	768	32	1.05±0.04	1.23±0.05
NOPI-425	-9.8	455	27	1.11±0.03	1.33±0.03
			Ion Exchangeable		
Sample	Location (m E)	U ppm	Th ppm	234U/238U	230Th/234U
NOPI-417	15.8	8	-	.86±0.04	-
NOPI-418	11.7	-	-	-	-
NOPI-419	9	-	-	-	-
NOPI-420	6.2	-	-	-	-
NOPI-421	3.3	23	-	0.82±0.03	-
NOPI-422	1.1	80	-	1.12±0.03	-
NOPI-423	-2.1	-	-	-	-
NOPI-424	-6.1	-	-	-	-
NOPI-425	-9.8	-	-	-	-
			Adsorbed		
Sample	Location (m E)	U ppm	Th ppm	234U/238U	230Th/234U
NOPI-417	15.8	251	-	1.08±0.03	-
NOPI-418	11.7	-	-	-	-
NOPI-419	9	-	-	-	-
NOPI-420	6.2	86	-	1.02±0.06	-
NOPI-421	3.3	146	-	1.30±0.03	0.46±0.01
NOPI-422	1.1	180	-	0.68±0.06	0.51±0.04
NOPI-423	-2.1	68	-	1.21±0.03	-
NOPI-424	-6.1	8	-	1.61±0.18	-
NOPI-425	-9.8	-	-	-	-
			Amorphous		
Sample	Location (m E)	U ppm	Th ppm	234U/238U	230Th/234U
NOPI-417	15.8	130	-	1.03±0.05	2.04±0.08
NOPI-418	11.7	65	-	1.36±0.03	1.16±0.02
NOPI-419	9	87	7	1.23±0.02	1.39±0.02
NOPI-420	6.2	271	-	1.00±0.04	0.60±0.04
NOPI-421	3.3	61	-	1.31±0.06	2.91±0.11
NOPI-422	1.1	71	-	1.22±0.02	3.66±0.08
NOPI-423	-2.1	-	-	-	-
NOPI-424	-6.1	-	-	-	-
NOPI-425	-9.8	27	-	1.32±0.05	2.57±0.07
			Crystalline		
Sample	Location (m E)	U ppm	Th ppm	234U/238U	230Th/234U
NOPI-417	15.8	-	-	-	-
NOPI-418	11.7	3237	-	0.96±0.02	1.58±0.03
NOPI-419	9	483	-	0.92±0.01	1.67±0.02
NOPI-420	6.2	-	-	-	-
NOPI-421	3.3	994	-	1.09±0.01	2.12±0.01
NOPI-422	1.1	668	-	1.24±0.01	1.53±0.01
NOPI-423	-2.1	86	-	1.25±0.07	-
NOPI-424	-6.1	41	-	1.16±0.08	-
NOPI-425	-9.8	28	-	0.94±0.07	1.84±0.10
			Residue		
Sample	Location (m E)	U ppm	Th ppm	234U/238U	230Th/234U
NOPI-417	15.8	-	-	-	-
NOPI-418	11.7	-	-	-	-
NOPI-419	9	-	-	-	-
NOPI-420	6.2	-	-	-	-
NOPI-421	3.3	-	-	-	-
NOPI-422	1.1	305	-	1.03±0.04	-
NOPI-423	-2.1	49	3	0.95±0.02	1.11±0.03
NOPI-424	-6.1	11	13	0.96±0.04	0.75±0.03
NOPI-425	-9.8	34	-	0.99±0.07	-

Sample	IE phase	AD phase	AM phase	CR phase	RES phase
NOPI-417	(*)	1.01 ± 0.05	1.09 ± 0.03	*	*
NOPI-418	(*)	(*)	1.32 ± 0.04	0.96 ± 0.02	(*)
NOPI-419	(*)	(*)	1.22 ± 0.02	0.93 ± 0.01	1.26 ± .11
NOPI-420	(*)	0.96 ± 0.06	0.93 ± 0.04	*	*
NOPI-421	0.69 ± 0.04	1.28 ± 0.03	1.22 ± 0.06	1.09 ± 0.01	1.04 ± 0.08
NOPI-422	1.19 ± 0.02	0.91 ± 0.09	1.30 ± 0.03	1.27 ± 0.01	1.13 ± 0.04
NOPI-423	6.45 ± 0.74	1.14 ± 0.03	1.05 ± 0.05	1.52 ± 0.09	0.916 ± 0.02
NOPI-424	5.78 ± 0.78	1.13 ± 0.19	1.05 ± 0.08	0.93 ± 0.07	0.939 ± 0.04
NOPI-425	1.09 ± 0.02	1.70 ± 0.6	1.38 ± 0.05	1.11 ± 0.08	0.82 ± 0.05
NOPI-426	0.87 ± 0.01	1.14 ± 0.03	5.75 ± 0.29	*	*
			(*) - bad resolution, measure again		
			* - sample not prepared for alpha spectrometer		

Sample	Spike	Mass (g)	Date	Experimentor
NOPI-417-IE	25B	0.4362	9/15/95	OCL
NOPI-417-AD	25B	0.4363	9/18/95	OCL
NOPI-417-AM	25B	1.1476	9/20/95	OCL
NOPI-417-CR	25B	2.1001	10/16/95	OCL
NOPI-417-RES	25B	0.4717	10/16/95	OCL
NOPI-418-IE	25B	0.7162		OCL
NOPI-418-AD	25B	0.7353		OCL
NOPI-418-AM	25B	1.3809		OCL
NOPI-418-CR	25A	3.0098		OCL
NOPI-419-IE	25C	1.5704	7/20/95	OCL
NOPI-419-AD	25C	1.4524	7/20/95	OCL
NOPI-419-AM	25C	2.8692	7/26/95	OCL
NOPI-419-CR	25B	0.7153	9/25/95	OCL
NOPI-419-RES	25C	0.7652	9/25/95	OCL
NOPI-420-IE	25B	1.3011	9/15/95	OCL
NOPI-420-AD	25B	1.3405	9/18/95	OCL
NOPI-420-AM	25B	2.5996	9/20/95	OCL
NOPI-420-CR	25B	304709	10/16/95	OCL
NOPI-420-RES	25B	1.224	10/16/95	OCL
NOPI-421-IE	25C	1.5633	8/7/95	OCL
NOPI-421-AD	25C	1.5747	8/10/95	OCL
NOPI-421-AM	25B	0.3974	8/11/95	OCL
NOPI-421-CR	25B	0.8101	9/25/95	OCL
NOPI-421-RES	25C	0.8026	9/25/95	OCL
NOPI-422-IE	25C	1.5137	8/7/95	OCL
NOPI-422-AD	25C	1.7232	8/10/95	OCL
NOPI-422-AM	25B	0.4021	8/11/95	OCL
NOPI-422-CR	25B	0.8071	9/25/95	OCL
NOPI-422-RES	25C	0.8401	9/25/95	OCL
NOPI-423-IE	25C	0.3085	6/7/95	OCL
NOPI-423-AD	25C	0.3185	6/8/95	OCL
NOPI-423-AM	25C	0.6301	6/10/95	OCL
NOPI-423-CR	25C	1.1208	6/12/95	OCL
NOPI-423-RES	25C	0.1507	7/7/95	OCL
NOPI-424-IE	25C	0.0862	6/8/95	OCL
NOPI-424-AD	25C	0.0956	6/9/95	OCL
NOPI-424-AM	25C	0.3726	6/11/95	OCL
NOPI-424-CR	25C	0.6553	6/12/95	OCL
NOPI-424-RES	25C	0.0603	7/7/95	OCL
NOPI-425-IE	25B	0.5203	7/20/95	OCL
NOPI-425-AD	25B	0.4927	7/20/95	OCL
NOPI-425-AM	25B	1.1051	7/26/95	OCL
NOPI-425-CR	25A	0.7628	9/25/95	OCL
NOPI-425-RES	25B	0.2681	9/25/95	OCL
NOPI-426-IE	25B	0.5022	9/15/95	OCL
NOPI-426-AD	25B	0.5158	9/18/95	OCL
NOPI-426-AM	25B	1.3464	9/20/95	OCL
NOPI-426-CR	25B	2.5026	10/16/95	OCL
NOPI-426-RES	25B	0.3724	10/16/95	OCL

OMAR'S sequential extraction spikes.
9P 1/3/96

Sequential Phase Extractions of 13m transect samples from NOPAL I Uranium Deposit

Objective: Determine Uranium and Thorium content along with Uranium and Thorium isotopic ratios in different mineral phases of samples collected from the NOPAL I natural analog site.

Method: Sequential phase extraction technique, Uranium/Thorium column separation, deposition on filters, and alpha counting.

Equipment:

- ALPHA-KING Multi-Channel Alpha Spectrometer
    - 576A dual spectrometer or 676 single spectrometer with ion
    - implanted silicon particle detectors
    - Model 920 multichannel buffer
    - APLHAMAT analysis software for acquisition control
    - MAESTRO II multichannel emulation software for analysis of data
- Thermolyne drying oven
- Ohaus analytical balance
- Centrifuge
- SI Vortex Genie hand homogenizer
- Burrell wrist shaker
- Hot plate
- infrared lamp
- perchloric fume hood
- agate mortar and pestle

Materials and Supplies:

- necessary glassware (e.g., petri dishes, beakers, volumetric flasks, etc...)
- necessary plastic ware (e.g., pp bottles, weighing boats, beakers)
- 50 mL polypropylene centrifuge tubes
- Eppendorf pipets and tips
- Teflon dish and lid for teflon bomb
- filters and filter funnels
- BIO-RAD 1.5 cm diameter columns
- stainless steel 1 inch planchettes
- 25mm membrane filters
- 50 mL polysulfone filter funnel

Reagents:

- concentrated HNO_3, $HClO_4$, HCl, HF, acetic acid, and ammonia
- 0.1 M, 1 M, 8 M, 9 M HCl
- 0.1 M, 7 M, 8 M HNO_3
- 0.05 M EDTA*
- 0.05 M ammonia
- nanopure water
- Cerous nitrate (0.5mg/mL) substrate*
- 25% hydrazine dihydrochloride
- 10 M NaOH
- 80% ethanol
- Ceric hydroxide (10 μg Ce/mL) substrate*
- 10% sodium hydrogen sulfate
- 20% titanium trichloride
- cerous fluoride (~10 μg Ce/mL) substrate
- 0.3 M sodium citrate
- 1 M $NaHCO_3$
- saturated NaCl solution
- acetone
- $^{232}U/^{228}Th$ spike
- sodium dithionite ($Na_2S_2O_4$)
- 1 M magnesium chloride
- Tamm's reagent: 28.4 g ammonium oxalate (MW = 142.1) dissolved in distilled water and added with 5.25 g citric acid (MW = 210.14) dissolved in distilled water until total volume of solution is 1 L.
- Morgan's reagent: 82.04 g sodium acetate dissolved in distilled water with pH adjusted to 5.0 using concentrated acetic acid.
- Fe carrier solution: 72.3 g ferric nitrate dissolved in distilled water to a volume of 1 L.
- BIO-RAD anion exchange resin (AG 1x8, 100-200 mesh chloride form)

Procedure:

Sample I.D. # __________
Date __________

Sample Preparation: Sample is obtained from bulk rock sample, crushed in an agate mortar and pestle, dried in oven, and cooled in dessicator.

Sample Mass ________ g

After weighing, powdered sample is transferred into 50 mL polypropylene (PP) tube.

Sequential Phase Extractions: Sample powders will undergo a series of phase extractions, separating the five main mineral phases of interest.

I. *Ion exchangeable phase:*

a. Add 50 mL of 1 M magesium chloride to powder in centrifuge tube. Shake for 1 hour on wristshaker.
b. Centrifuge mixture at 10000 rpm for 10 minutes.
c. Transfer supernate into a clean and labeled PP bottle. Label bottle as "IE."
d. Wash residue in PP tube with 30 mL of ultrapure water. Centrifuge for 10 minutes and decant supernate into labeled PP bottle.
e. Add appropriate amount of spike to saved supernate and record spike weight (~10% total U in sample). Allow solution to equilibrate. Transfer half of solution into a cleaned teflon beaker.

Spike # __________ Reference Date ________
Reference Activity ________ Spike weight ________ g

f. Evaporate solution on hot plate. Add 2 mL each of concetrated nitric and perchloric acids and evaporate solution until perchloric fumes.
g. Add 2 mL of concentrated HCL to dissolve residue and 8 mL of ultrapure water to dilute to 2 M.
h. Transfer solution to a clean 50 mLcentrifuge tube. Add Fe carrier and allow to equilibrate. Add concentrated ammonia to coprecipitate actinides. Centrifuge and decant supernate. Wash precipitate at least twice with 0.05 M ammonia.
i. Dissolve precipitate in 3 mL of concentrated HCl and then add 1 mL of ultrapure water to dilute to 9M.

II. *Adsorbed phase:*

a. Add 30 mL of Morgan's reagent and .03 mL of 0.02 M EDTA to residue in 50 mL PP tube.
b. Shake mixture for six hours on wristshaker.
c. Centrifuge mixture at 10000 rpm for 10 minutes.
d. Label a cleaned PP bottle as "AD" and transfer supernate into this bottle.
e. To remaining residue, wash with 30 mL of ultrapure water and centrifuge for 10 minutes. Transfer supernate to the labeled PP bottle.
f. To supernate solution, add radioactive spike and record spike weight. Follow with addition of 0.5 mL of Fe carrier solution and leave overnight to equilibrate.

Spike # __________ Reference Date ________
Reference Activity ________ Spike weight ________ g

g. Transfer half of this solution to a cleaned teflon beaker. The supernate in the bottle will be saved.
h. Evaporate supernate in teflon beaker to dryness on hotplate.
i. Add 2 mL each of concentrated nitric and perchloric acids. Gently heat solution until color changes to a pale straw or water white color. Cover to reduce evaporation.
j. Evaporate to dryness on hot plate.
k. Add 5 mL each of 8 M HCl and ultrapure water to teflon beaker to dissolve residue. Follow by transferring solution into a cleaned 50 mL PP tube.
l. Add concentrated ammonia to coprecipitate actinides. Centrifuge and decant supernate. Wash precipitate at least twice with 0.05 M ammonia.
m. Dissolve precipitate in 3 mL of concentrated HCl and then add 1 mL of ultrapure water to dilute to 9M.

III. *Amorphous phase*

a. Add 50 mL of Tamm's reagent to residue in 50 mL PP tube.
b. Solution mixture must be shaken in dark for four hours. This can be accomplished by covering PP tube with aluminum foil and shaking solution in a dark room. Check solution hourly by opening cap and releasing any excess pressure.
c. Centrifuge mixture at 10000 rpm for 10 minutes
d. Label a cleaned PP bottle as "AM" and transfer supernate into this bottle.
e. Add 15 mL of oxalate solution to residue and shake for 30 minutes. Centrifuge at 10000 rpm for 10 minutes and add supernate to lableled PP bottle.
f. To remaining residue, wash with 30 mL of ultrapure water and centrifuge for 10 minutes. Transfer supernate to the labeled PP bottle.
g. To supernate solution, add radioactive spike and record spike weight.

Spike # __________ Reference Date ________
Reference Activity ________ Spike weight ________ g

h. Transfer half of this solution to a cleaned teflon beaker. The supernate in the bottle will be saved.
i. Evaporate supernate in teflon beaker to dryness on hotplate.
j. Add 2 mL each of concentrated nitric and perchloric acids. Gently heat solution until color changes to a pale straw or water white color. Cover to reduce evaporation.
k. Evaporate to dryness on hot plate.
l. Add 5 mL each of 8 M HCl and ultrapure water to teflon beaker to dissolve

residue. Follow by transferring solution into a cleaned 50 mL PP tube.
m. Add concentrated ammonia to coprecipitate actinides. Centrifuge and decant supernate. Wash precipitate at least twice with 0.05 M ammonia.
n. Dissolve precipitate in 3 mL of concentrated HCl and then add 1 mL of ultrapure water to dilute to 9M.

IV. *Crystalline iron oxides*

a. Add 40 mL of 0.3 M sodium citrate and 5 mL of 1 M sodium bicarbonate to residue in 50 mL centrifuge tube.
b. Place tube into a water bath at 75-80 degrees.
c. Add 1 g of solid sodium dithionite to centrifuge tube and mix for 1 minute. Continue occasional mixing for five minutes.
d. Repeat step c twice.
e. Add 10 mL of saturated sodium chloride and 10 mL of acetone into PP tube. Mix solution, place in warm water bath, and centrifuge for five minutes at 3000 rpm.
d. Decant supernate into a cleaned PP bottle labeled "CR." Observe color of residue. If not grey or off white, residue still contains Fe-oxides and extraction steps must be repeated.
e. Add radioactive spike and record spike weight. Allow solution to equilibrate overnight.

Spike # ___________ Reference Date _________

Reference Activity _________ Spike weight ________ g

f. Transer half of solution into a clean teflon beaker. Evaporate solution in teflon beaker to dryness and save the other fraction in PP bottle.
g. Add concentrated nitric until bubbling ceases. Follow by evaporating solution on hotplate.
h. Follow steps k-l from extraction II.

V. Final residue is spiked and dissolved by acid digestion in microwave. Procedure is outlined below.

a. Consult the CEM Microwave Sample Preparation Applications Manual for the microwave sample preparation note for the type of sample being dissolved. This discusses the amount of sample and reagents to be used, and program parameters to be entered for microwave digestion.

Application note ______________

b. Record the dry weight of the sample and place in teflon PFA vessel.

Sample dry weight ______ g

c. Quantitatively add a known amount of radioactive spike to the PFA vessel.

Spike # ___________ Reference Date _________

Reference Activity _________ Spike weight _________ g

d. Add reagents to vessel and record volumes used.

Reagents	Volume (mL)
_________	______
_________	______
_________	______
_________	______

e. Seal vessel, place on turntable in microwave, enter and run digestion program. If after digestion, sample is not completely dissolved, repeat this step.
d. Quantitatively transfer half of the sample into a cleaned teflon beaker washing sides of PFA vessel with ultrapure water.
e. Split sample into two parts; half is saved and stored in a labeled PP bottle while the other half is kept in teflon beaker.
f. To sample solution in teflon beaker, add 1 mL of perchloric acid. Evaporate over hot plate until perchloric fumes.
g. Add 2 mL of centrated HCl to dissolve residue and 8 mL of ultrapure water. Transfer solution into a 50 mL PP tube.
h. Add 0.5 mL of Fe carrier and allow to equilibrate. Add concentrated ammonia to solution and precipitate out actinides. Decant out supernate and save precipitate. Wash precipitate twice with .05 M ammonia.
i. Dissolve precipitate in 3 mL of concentrated HCl. Add 1 mL of ultrapure water to dilute to 9M.

Column Separation:

Resin: BIO-RAD Anion Exchange Resin AG 1-X8 100-200 mesh chloride form.
(Lot # __________________)

<u>Main Column</u> (Biorad 1.5 cm diameter column with 10 cm resin; prewash with 4-5 column vols 9M HCl)

Load sample in 9M HCl and allow to drain ___
Wash 3 volumes (~35 ml) 9M HCl --> Th ___ ___ ___
Elute 4 volumes (~50 ml) 0.1M HCl --> U and Fe ___ ___ ___ ___

Separation Date ____________

***Note: May work on U and Th fractions simultaneously from this point on.

Thorium Column (Biorad 0.7 cm diameter column with 10 cm resin; prewash with 4-5 column vols 8M HNO_3)

Heat Th fraction to evaporate HCl ___
Add ~5 ml conc HNO_3 to dissolve residue ___
Add equal vol (~5 ml) DI water so soln 8M HNO_3 ___
Load onto column in 8M HNO_3 ___
Wash 3-4 column vols 8M HNO_3 ___ ___ ___ ___
Elute 4-5 column vols 9M HCl --> Th ___ ___ ___ ___

Uranium Column (Biorad 0.7 cm diameter column with 10 cm resin; prewash with 4-5 column vols 8M HNO_3)

Evaoprate U fraction to near dryness ___
Pick up in about 2 ml conc HNO_3 ___
Dilute with about 2 ml DI water to approx 8M HNO_3 ___
Load onto column in 8M HNO_3 ___
Wash 2 vols (8-10 ml) 8M HNO_3 --> Fe ___ ___
Elute 4-5 vols 0.1M HCl --> U ___ ___ ___ ___

Source Preparation:

Thorium - OH^- precipitation onto filter

1. Evaporate solution containing Th to near dryness.
2. Add 6 ml 0.05 M EDTA soln to dissolve residue, transfer soln to a 50 ml PP centrifuge tube and place tube in boiling water for a few minutes.
3. Add 100 µl purified cerous nitrate (0.5 mg/ml Ce) to precipitate hydroxides. Mix, add

2 drops 25% hydrazine dihydrochloride, and 2 ml of 10M NaOH.

4. Place tube in boiling water bath for 10 minutes, remove, and place tube in cold water for 10 minutes to ensure complete precipitation
5. Wet a 25 mm membrane filter with 80% ethanol and place in a 50 ml polysulfone filter funnel.
6. Shake bottle of substrate suspension (ceric hydroxide containing 10 μg Ce/ml) vigorously and draw 2 consecutive 5 ml portions through the filter with full suction. Allow each portion to suck dry for 10-15 sec.
7. Without interrupting suction, pour the sample into the filter chimney and allow to suck dry.
8. While the sample is still filtering, add 0.5 ml 10M NaOH to the sample tube and about 5 ml ultrapure water down the sides of the tube. After the sample has sucked dry, swirl the wash solution around the sides and add it to the filter chimney.
9. Wash tube, filter chimney, precipitate, and filter with three consecutive 5 ml portions of 80% ethanol.
10. Suck filter dry for about 15 sec and remove the chimney and filter carefully without interrupting the suction. Transfer filter to a plastic container and at low temperature (~60°C).
11. Glue to tape the dry filter onto a 1 inch stainless steel planchet and count.

Th Counting Date______________

Uranium - F^- precipitation onto filter

1. To the solution containing U, add 1 ml of 10% sodium hydrogen sulfate and 100 μl puriified cerous nitrate (0.5 mg/ml Ce, 50 μg of Ce carrier) and evaporate the solution until completely dry and no more fumes are given off.
2. Add 2 ml of 1M HCl to the beaker containing the purified U fraction and heat gently to dissolve the sodium hydrogen sulfate cake and any possible insoluble double salts with the Ce carrier.
3. Transfer solution to a 50 ml polycarbonate centrifuge tube with two more 2 ml portions of 1M HCl.
4. Add 2 drops of 20% titanium trichloride which should produce a strong violet color. If not, iron is probably present and a few more drops of titanium trichloride must be added to produce a permanent violet color or reduction and precipitation of U will be incomplete.
5. Add 0.5 ml (10 drops) of 48% HF. The violet color dissappears and any slight turbidity should clear up.
6. Mix thoroughly and allow solution to stand for 30 min in a cold water bath to obtain complete precipitation of cerous and uranous fluorides.
7. Place the tube in an ultrasonic bath for 1 min to disperse the precipitate.
8. Mount the precipitate on a 25 mm membrane filter previously treated with two 5 ml portions of cerous fluoride substrate as described above.

9. After sucking the precipitate dry, wash with 5 ml of water containing 2 drops of 48% HF and then with 80% ethanol.
10. Dry and analyze as described above.

U Counting Date_______________

U and Th Isotope Activities

FILENAME= NP417IEU.CHN
NP417IET.CHN

Sample # **NOPI-417-IE**
Analyst **JDP**

Sep. date **9/15/95**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.4392	0.4362	454.83	1/22/93	966	443.3956

Th-228/U-232= 0.6810227

Counting time for Th=	11688	(mins.)
Days btwn. sep. and count.=	10	(days)
CF for Th-228=	0.9861533	

Counting time for U=	11686	(mins.)
Days btwn. sep. and count.=	10	(days)
CF for U-232=	1.0134729	

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
0	22376	5517	6415

U-238 counts	U-234 counts	U-232 counts
1108	960	81435

Bkgd	Bkgd	Bkgd	bkgd
0	12	65	50

bkgd	bkgd	bkgd
3	4	35

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
0	22364	5186.4704	6365

U-238* counts	U-234* counts	U-232sp counts
1105	956	80317.884

		±	
U-238(dpm/g)=	6.058495	±	0.183244
U-234(dpm/g)=	5.241558	±	0.170165
Th-232(dpm/g)=	0	±	#DIV/0!
Th-230(dpm/g)=	1293.165	±	19.43832
U-234/U-238=	0.865158	±	0.038147
Th-230/U-234=	246.7139	±	8.131673
Th-230/Th-232=	#DIV/0!	±	#DIV/0!
U234/Th-232=	#DIV/0!	±	#DIV/0!

Decay constant (m-1)	U-238	Th-232
	2.948E-16	9.413E-17

U(ppb)= 8121.132

Th(ppb)= 0

	Spike 25A 10/9/92	Spike 25B	Spide 25C
Th-228 (dpm/g)=	3022.8726	301.96249	30.180361

U and Th Isotope Activities

FILENAME= NP417ADU.CHN
NP417ADT.CHN

Sample # **NOPI-417-AD**
Analyst **JDP**

Sep. date **9/20/95**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.4392	0.4363	454.83	1/22/93	971	443.3372

Th-228/U-232= 0.6829223

Counting time for Th=	0	(mins.)	Counting time for U=	2580.84	(mins.)
Days btwn. sep. and count.=	7	(days)	Days btwn. sep. and count.=	11	(days)
CF for Th-228=	#DIV/0!		CF for U-232=	1.0114164	

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
0	0	0	0
Bkgd	Bkgd	Bkgd	bkgd
0	0	0	0
Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
0	0	#DIV/0!	0

U-238 counts	U-234 counts	U-232 counts
2255	2448	5383
bkgd	bkgd	bkgd
3	6	25
U-238* counts	U-234* counts	U-232sp counts
2252	2442	5297.5216

		±	
U-238(dpm/g)=	187.2202	±	4.696313
U-234(dpm/g)=	203.0159	±	4.949037
Th-232(dpm/g)=	#DIV/0!	±	#DIV/0!
Th-230(dpm/g)=	#DIV/0!	±	#DIV/0!
U-234/U-238=	1.084369	±	0.031651
Th-230/U-234=	#DIV/0!	±	#DIV/0!
Th-230/Th-232=	#DIV/0!	±	#DIV/0!
U234/Th-232=	#DIV/0!	±	#DIV/0!

Decay constant (m-1)	U-238	Th-232
	2.948E-16	9.413E-17

U(ppb)= 250960

Th(ppb)= #DIV/0!

	Spike 25A	Spike 25B	Spide 25C
	10/9/92		
Th-228 (dpm/g)=	3030.905	302.76487	30.260557

U and Th Isotope Activities

FILENAME= NP417AMU.CHN
NP417AMT.CHN

Sample # **NOPI-417-AM**
Analyst **JDP**

Sep. date 9/20/95

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.4392	1.1467	454.83	1/22/93	971	443.3372

Th-228/U-232= 0.6829223

Counting time for Th=	2580.84	(mins.)	Counting time for U=	2580.84	(mins.)
Days btwn. sep. and count.=	10	(days)	Days btwn. sep. and count.=	11	(days)
CF for Th-228=	0.9892492		CF for U-232=	1.0114164	

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
0	3529	13882	6017
Bkgd	Bkgd	Bkgd	bkgd
0	11	40	350

U-238 counts	U-234 counts	U-232 counts
860	886	10353
bkgd	bkgd	bkgd
3	6	25

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
0	3518	13688.815	5667

U-238* counts	U-234* counts	U-232sp counts
857	880	10211.423

		±	
U-238(dpm/g)=	97.14405	±	3.447425
U-234(dpm/g)=	99.75119	±	3.49166
Th-232(dpm/g)=	0	±	#DIV/0!
Th-230(dpm/g)=	203.1529	±	3.82986
U-234/U-238=	1.026838	±	0.049154
Th-230/U-234=	2.036596	±	0.076529
Th-230/Th-232=	#DIV/0!	±	#DIV/0!
U234/Th-232=	#DIV/0!	±	#DIV/0!

Decay constant (m-1)	U-238	Th-232
	2.948E-16	9.413E-17

U(ppb)= 130217.1

Th(ppb)= 0

	Spike 25A 10/9/92	Spike 25B	Spide 25C
Th-228 (dpm/g)=	3030.905	302.76487	30.260557

NP417ADu

```
CB # 1       ACQ 10-03-95  AT 14:16:57   RT : 154857.6   LT : 154850.7
             No detector description was entered
             No sample description was entered

ROI #  9-1   RANGE :   75 =    4.05MeV  to  159 =    4.25MeV
             AREA : Gross = 2353       Net = 2255       +/- 60
             CENTROID : 131.33  =    4.18MeV
             SHAPE : Fwhm =   0.05MeV    Fwtm =   0.12MeV

             ID : No close library match

ROI #  9-2   RANGE :  316 =    4.61MeV  to  404 =    4.82MeV
             AREA : Gross = 2515       Net = 2448       +/- 58
             CENTROID : 380.30  =    4.76MeV
             SHAPE : Fwhm =   0.07MeV    Fwtm =   0.13MeV

             ID : No close library match

ROI #  9-3   RANGE :  560 =    5.18MeV  to  640 =    5.37MeV
             AREA : Gross = 5601       Net = 5383       +/- 90
             CENTROID : 616.94  =    5.31MeV
             SHAPE : Fwhm =   0.06MeV    Fwtm =   0.13MeV

             ID : No close library match
```

NP 417AMU.CHN

```
MCB # 1       ACQ 10-03-95  AT 14:16:58   RT : 154857.5   LT : 154850.6
              No detector description was entered
              No sample description was entered

ROI # 12-1    RANGE :   98 =    4.10MeV  to  155 =    4.24MeV
              AREA : Gross = 985       Net = 860        +/- 44
              CENTROID : 133.33  =    4.18MeV
              SHAPE : Fwhm =   0.05MeV    Fwtm =   0.08MeV

              ID : No close library match


ROI # 12-2    RANGE :  336 =    4.65MeV  to  406 =    4.82MeV
              AREA : Gross = 1017      Net = 886        +/- 48
              CENTROID : 383.84  =    4.77MeV
              SHAPE : Fwhm =   0.04MeV    Fwtm =   0.11MeV

              ID : No close library match


ROI # 12-3    RANGE :  553 =    5.16MeV  to  644 =    5.37MeV
              AREA : Gross = 10767     Net = 10353      +/- 128
              CENTROID : 619.17  =    5.31MeV
              SHAPE : Fwhm =   0.06MeV    Fwtm =   0.13MeV

              ID : No close library match
```

NP417AMT.CHN

```
MC   1      ACQ 10-03-95  AT 14:16:57   RT : 154857.7   LT : 154850.8
            No detector description was entered
            No sample description was entered

ROI # 5-1   RANGE :  278 =    4.46MeV  to  378 =    4.71MeV
            AREA : Gross = 3967      Net = 3529       +/- 102
            CENTROID : 359.82  =    4.66MeV
            SHAPE : Fwhm =   0.06MeV    Fwtm =   0.18MeV

            ID : No close library match


ROI # 5-2   RANGE :  562 =    5.17MeV  to  676 =    5.46MeV
            AREA : Gross = 15879     Net = 13882      +/- 224
            CENTROID : 652.60  =    5.40MeV
            SHAPE : Fwhm =   0.06MeV    Fwtm =   0.19MeV

            ID : No close library match


ROI # 5-3   RANGE :  693 =    5.51MeV  to  780 =    5.73MeV
            AREA : Gross = 7411      Net = 6017       +/- 158
            CENTROID : 756.50  =    5.67MeV
            SHAPE : Fwhm =   0.08MeV    Fwtm =   0.16MeV

            ID : No close library match
```

NP417IEU.CHW

MCB # 1   ACQ 10-05-95 AT 10:30:29   RT : 701305.6   LT : 701200.9
No detector description was entered
NOPI-417 U ion exchangeable

ROI # 7-1   RANGE : 80 = 4.08MeV to 152 = 4.25MeV
AREA : Gross = 1389   Net = 1108   +/- 65
CENTROID : 139.46 = 4.22MeV
SHAPE : Fwhm = 0.06MeV   Fwtm = 0.11MeV

ID : No close library match

ROI # 7-2   RANGE : 269 = 4.52MeV to 353 = 4.72MeV
AREA : Gross = 1994   Net = 960   +/- 121
CENTROID : 327.98 = 4.66MeV
SHAPE : Fwhm = 0.00MeV   Fwtm = 0.14MeV

ID : No close library match

ROI # 7-3   RANGE : 539 = 5.15MeV to 645 = 5.40MeV
AREA : Gross = 83843   Net = 81435   +/- 349
CENTROID : 617.34 = 5.33MeV
SHAPE : Fwhm = 0.08MeV   Fwtm = 0.13MeV

ID : No close library match

NP 417IET.CHN

```
MCB # 1       ACQ 10-05-95  AT 10:30:29   RT : 701423.4   LT : 701318.7
              No detector description was entered
              NOPI-417 Th ion exchangeable

ROI #  9-1    RANGE :  234 =    4.42MeV  to  371 =    4.74MeV
              AREA : Gross = 25136     Net = 22376      +/- 288
              CENTROID : 333.64  =    4.65MeV
              SHAPE : Fwhm =   0.14MeV    Fwtm =   0.24MeV

              ID : No close library match


ROI #  9-2    RANGE :  602 =    5.28MeV  to  692 =    5.49MeV
              AREA : Gross = 8170      Net = 5517       +/- 208
              CENTROID : 664.96  =    5.43MeV
              SHAPE : Fwhm =   0.08MeV    Fwtm =   0.16MeV

              ID : No close library match


ROI #  9-3    RANGE :  711 =    5.53MeV  to  804 =    5.75MeV
              AREA : Gross = 8436      Net = 6415       +/- 190
              CENTROID : 777.15  =    5.69MeV
              SHAPE : Fwhm =   0.08MeV    Fwtm =   0.18MeV

              ID : No close library match
```

U and Th Isotope Activities

FILENAME= NP418AMU.CHN
NP418AMT.CHN

Sample # **NOPI-418-AM**
Analyst **JDP**

Sep. date 5/25/95

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
1.0171	1.3809	454.83	1/22/93	853	444.7182

Th-228/U-232= 0.6358101

Counting time for Th=	2764.31	(mins.)	Counting time for U=	1164.72	(mins.)
Days btwn. sep. and count.=	5	(days)	Days btwn. sep. and count.=	5	(days)
CF for Th-228=	0.9941053		CF for U-232=	1.0052041	

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
0	17587	90250	43420

U-238 counts	U-234 counts	U-232 counts
4938	6717	62079

Bkgd	Bkgd	Bkgd	bkgd
0	14	46	18

bkgd	bkgd	bkgd
4	9	21

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
0	17573	88424.93	43402

U-238* counts	U-234* counts	U-232sp counts
4934	6708	61736.716

		±	
U-238(dpm/g)=	48.25464	±	0.713483
U-234(dpm/g)=	65.60441	±	0.842664
Th-232(dpm/g)=	0	±	#DIV/0!
Th-230(dpm/g)=	76.29255	±	0.628849
U-234/U-238=	1.359546	±	0.025485
Th-230/U-234=	1.162918	±	0.01668
Th-230/Th-232=	#DIV/0!	±	#DIV/0!
U234/Th-232=	#DIV/0!	±	#DIV/0!

Decay constant (m-1)	U-238	Th-232
	2.948E-16	9.413E-17

U(ppb)= 64683.11

Th(ppb)= 0

	Spike 25A 10/9/92	Spike 25B	Spide 25C
Th-228 (dpm/g)=	2830.6046	282.75635	28.260757

U and Th Isotope Activities

FILENAME= NP418CRU.CHN
NP418CRT.CHN

Sample # **NOPI-418-CR**
Analyst **JDP**

Sep. date **5/27/95**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
1.0171	3.0098	4553.22	1/22/93	855	4451.758

Th-228/U-232= 0.6366458

Counting time for Th= 1666.67 (mins.)
Days btwn. sep. and count.= 8 (days)
CF for Th-228= 0.9915259

Counting time for U= 1164.85 (mins.)
Days btwn. sep. and count.= 8 (days)
CF for U-232= 1.0080803

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
0	6448	15128	9694

U-238 counts	U-234 counts	U-232 counts
3539	3404	19447

Bkgd	Bkgd	Bkgd	bkgd
0	10	40	18

bkgd	bkgd	bkgd
7	8	25

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
0	6438	14699.739	9676

U-238* counts	U-234* counts	U-232sp counts
3532	3396	19266.323

		±	
U-238(dpm/g)=	2415.057	±	44.13595
U-234(dpm/g)=	2322.065	±	43.14256
Th-232(dpm/g)=	0	±	#DIV/0!
Th-230(dpm/g)=	3673.202	±	54.62947
U-234/U-238=	0.961495	±	0.023083
Th-230/U-234=	1.581869	±	0.033514
Th-230/Th-232=	#DIV/0!	±	#DIV/0!
U234/Th-232=	#DIV/0!	±	#DIV/0!

Decay constant (m-1)	U-238	Th-232
	2.948E-16	9.413E-17

U(ppb)= 3237272

Th(ppb)= 0

	Spike 25A 10/9/92	Spike 25B	Spide 25C
Th-228 (dpm/g)=	2834.1931	283.11481	28.296585

NP418CRU.CHN

MCB # 1	ACQ 06-05-95 AT 13:42:09	RT : 69894.0	LT : 69891.1	
	No detector description was entered			
	channel 10 background 6/5/95			
ROI # 10-1	RANGE : 63 to 142			
	AREA : Gross = 3620	Net = 3539	+/- 67	
	CENTROID : 116.83			
	SHAPE : Fwhm = 25.67 Channels	Fwtm = 51.12 Channels		
ROI # 10-2	RANGE : 311 to 393			
	AREA : Gross = 3557	Net = 3404	+/- 73	
	CENTROID : 367.20			
	SHAPE : Fwhm = 23.68 Channels	Fwtm = 52.03 Channels		
ROI # 10-3	RANGE : 547 to 627			
	AREA : Gross = 19972	Net = 19447	+/- 161	
	CENTROID : 602.23			
	SHAPE : Fwhm = 21.34 Channels	Fwtm = 54.15 Channels		

NP418CRT.CHW

```
MCB # 1      ACQ 06-09-95  AT 13:16:45   RT : 100001.2   LT : 100000.0
             No detector description was entered
             Th count NOPI-418 "CR" phase channel 1-6/12/95

ROI #  1-1   RANGE :  268 to  352
             AREA : Gross = 6597      Net = 6448       +/- 92
             CENTROID : 334.76
             SHAPE : Fwhm =  17.91 Channels   Fwtm =  49.60 Channels


ROI #  1-2   RANGE :  561 to  654
             AREA : Gross = 16040     Net = 15128      +/- 169
             CENTROID : 630.68
             SHAPE : Fwhm =  17.67 Channels   Fwtm =  58.63 Channels


ROI #  1-3   RANGE :  674 to  758
             AREA : Gross = 10487     Net = 9694       +/- 142
             CENTROID : 733.77
             SHAPE : Fwhm =  25.67 Channels   Fwtm =  52.20 Channels
```

NP418 AMU.CHN

MCB # 1	ACQ 06-05-95 AT 13:42:09	RT : 69886.0	LT : 69883.2	
	No detector description was entered			
	U count "AM" phase-channel 9 6/6/95			
ROI # 9-1	RANGE : 74 to 157			
	AREA : Gross = 5232	Net = 4938	+/- 94	
	CENTROID : 129.42			
	SHAPE : Fwhm = 25.97 Channels	Fwtm = 52.50 Channels		
ROI # 9-2	RANGE : 316 to 410			
	AREA : Gross = 7603	Net = 6717	+/- 141	
	CENTROID : 376.90			
	SHAPE : Fwhm = 31.22 Channels	Fwtm = 60.12 Channels		
ROI # 9-3	RANGE : 552 to 641			
	AREA : Gross = 65917	Net = 62079	+/- 340	
	CENTROID : 613.29			
	SHAPE : Fwhm = 37.75 Channels	Fwtm = 60.24 Channels		

NP418 AMT. CHW

MCB # 1 ACQ 06-07-95 AT 12:20:10 RT : 165864.5 LT : 165858.6
No detector description was entered
Th count NOPI-418 "AM" phase channel 1-6/9/95

ROI # 1-1 RANGE : 231 to 351
AREA : Gross = 21741 Net = 17587 +/- 312
CENTROID : 324.16
SHAPE : Fwhm = 47.37 Channels Fwtm = 79.59 Channels

ROI # 1-2 RANGE : 549 to 652
AREA : Gross = 103822 Net = 90250 +/- 559
CENTROID : 624.68
SHAPE : Fwhm = 48.68 Channels Fwtm = 76.99 Channels

ROI # 1-3 RANGE : 665 to 752
AREA : Gross = 49975 Net = 43420 +/- 365
CENTROID : 727.63
SHAPE : Fwhm = 40.54 Channels Fwtm = 67.39 Channels

U and Th Isotope Activities

FILENAME= NP419AMU.CHN
NP419AMT.CHN

Sample # **NOPI-419-AM**
Analyst **JDP**

Sep. date **7/22/95**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.4499	2.8692	45.459	1/22/93	911	44.38046

Th-228/U-232= 0.6595737

Counting time for Th=	9912.89	(mins.)	Counting time for U=	9912.89	(mins.)
Days btwn. sep. and count.=	4	(days)	Days btwn. sep. and count.=	4	(days)
CF for Th-228=	0.9926465		CF for U-232=	1.0071566	

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
164	9724	17234	15340

U-238 counts	U-234 counts	U-232 counts
12008	14765	52727

Bkgd	Bkgd	Bkgd	bkgd
7	29	54	55

bkgd	bkgd	bkgd
8	9	28

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
157	9695	16334.162	15285

U-238* counts	U-234* counts	U-232sp counts
12000	14756	52324.536

U-238(dpm/g)=	64.91013	±	0.656342
U-234(dpm/g)=	79.81782	±	0.743178
Th-232(dpm/g)=	1.794332	±	0.140779
Th-230(dpm/g)=	110.8028	±	1.405333
U-234/U-238=	1.229667	±	0.015111
Th-230/U-234=	1.388197	±	0.01813
Th-230/Th-232=	61.75159	±	4.862482
U234/Th-232=	44.48332	±	3.514542

Decay constant (m-1)	U-238	Th-232
	2.948E-16	9.413E-17

U(ppb)= 87009.01

Th(ppb)= 7343.522

	Spike 25A 10/9/92	Spike 25B	Spide 25C
Th-228 (dpm/g)=	2931.909	292.87591	29.272181

U and Th Isotope Activities

FILENAME= NP419CRU.CHN
NP419CRT.CHN

Sample # **NOPI-419-CR**
Analyst **JDP**

Sep. date 7/28/95

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.4499	0.7153	454.83	1/22/93	917	443.9687

Th-228/U-232= 0.6619629

Counting time for Th= 11694.69 (mins.)
Days btwn. sep. and count.= 7 (days)
CF for Th-228= 0.9890903

Counting time for U= 11692.48 (mins.)
Days btwn. sep. and count.= 7 (days)
CF for U-232= 1.0106159

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
0	55031	47983	35573
Bkgd	Bkgd	Bkgd	bkgd
0	25	21	21

U-238 counts	U-234 counts	U-232 counts
11465	10526	22700
bkgd	bkgd	bkgd
8	18	37

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
0	55006	46585.985	35552

U-238* counts	U-234* counts	U-232sp counts
11457	10508	22424.94

U-238(dpm/g)=	360.6319	±	4.131949
U-234(dpm/g)=	330.7603	±	3.900387
Th-232(dpm/g)=	0	±	#DIV/0!
Th-230(dpm/g)=	551.7127	±	3.445988
U-234/U-238=	0.917169	±	0.012381
Th-230/U-234=	1.668014	±	0.017745
Th-230/Th-232=	#DIV/0!	±	#DIV/0!
U234/Th-232=	#DIV/0!	±	#DIV/0!

Decay constant (m-1)	U-238	Th-232
	2.948E-16	9.413E-17

U(ppb)= 483410.4

Th(ppb)= 0

	Spike 25A 10/9/92	Spike 25B	Spide 25C
Th-228 (dpm/g)=	2942.0687	293.89078	29.373614

NP419CRT.CHN

MCB # 1 ACQ 10-05-95 AT 10:30:30 RT : 701786.2 LT : 701681.5
No detector description was entered
NOPI-419 Th crystalline

ROI # 15-1 RANGE : 210 = 4.39MeV to 368 = 4.76MeV
AREA : Gross = 57232 Net = 55031 +/- 333
CENTROID : 332.94 = 4.68MeV
SHAPE : Fwhm = 0.11MeV Fwtm = 0.20MeV

ID : No close library match

ROI # 15-2 RANGE : 591 = 5.28MeV to 685 = 5.50MeV
AREA : Gross = 56898 Net = 47983 +/- 425
CENTROID : 656.52 = 5.44MeV
SHAPE : Fwhm = 0.07MeV Fwtm = 0.17MeV

ID : No close library match

ROI # 15-3 RANGE : 706 = 5.55MeV to 797 = 5.76MeV
AREA : Gross = 40296 Net = 35573 +/- 321
CENTROID : 769.24 = 5.70MeV
SHAPE : Fwhm = 0.07MeV Fwtm = 0.14MeV

ID : No close library match

NP419CRU.CHN

```
MCB # 1       ACQ 10-05-95  AT 10:30:29   RT : 701653.8   LT : 701549.1
              No detector description was entered
              NOPI-419 U crystalline

ROI # 11-1    RANGE :   67 =    4.03MeV  to  168 =    4.27MeV
              AREA : Gross = 11889     Net = 11465      +/- 135
              CENTROID : 137.37  =    4.20MeV
              SHAPE : Fwhm =   0.08MeV    Fwtm =   0.14MeV

              ID : No close library match


ROI # 11-2    RANGE :  322 =    4.62MeV  to  416 =    4.84MeV
              AREA : Gross = 11634     Net = 10526      +/- 164
              CENTROID : 388.60  =    4.77MeV
              SHAPE : Fwhm =   0.07MeV    Fwtm =   0.14MeV

              ID : No close library match


ROI # 11-3    RANGE :  561 =    5.17MeV  to  653 =    5.38MeV
              AREA : Gross = 24219     Net = 22700      +/- 211
              CENTROID : 626.18  =    5.32MeV
              SHAPE : Fwhm =   0.08MeV    Fwtm =   0.14MeV

              ID : No close library match
```

NP419AMU.CHN

MC[illegible] 1 ACQ 08-18-95 AT 12:54:19 RT : 594782.8 LT : 594773.2
No detector description was entered
NOPI 419 U count "AM" phase-channel 10-8/17/95

ROI # 10-1 RANGE : 44 to 148
AREA : Gross = 12480 Net = 12008 +/- 141
CENTROID : 117.29
SHAPE : Fwhm = 30.43 Channels Fwtm = 57.10 Channels

ROI # 10-2 RANGE : 293 to 401
AREA : Gross = 15436 Net = 14765 +/- 162
CENTROID : 365.75
SHAPE : Fwhm = 34.65 Channels Fwtm = 60.63 Channels

ROI # 10-3 RANGE : 541 to 631
AREA : Gross = 55457 Net = 52727 +/- 302
CENTROID : 601.56
SHAPE : Fwhm = 37.64 Channels Fwtm = 59.66 Channels

NP419amt.chn

```
MCB   1     ACQ 08-18-95   AT 12:54:20   RT : 594782.4   LT : 594772.7
            No detector description was entered
            No sample description was entered

ROI # 16-1  RANGE :   38 to   75
            AREA : Gross = 249       Net = 164        +/- 25
            CENTROID : 56.22
            SHAPE : Fwhm =   2.22 Channels   Fwtm =  25.68 Channels

ROI # 16-2  RANGE :  266 to  366
            AREA : Gross = 10664     Net = 9724       +/- 157
            CENTROID : 343.26
            SHAPE : Fwhm =  23.34 Channels   Fwtm =  65.61 Channels

ROI # 16-3  RANGE :  596 to  694
            AREA : Gross = 19394     Net = 17234      +/- 225
            CENTROID : 666.49
            SHAPE : Fwhm =  21.10 Channels   Fwtm =  66.91 Channels

ROI # 16-4  RANGE :  714 to  806
            AREA : Gross = 17124     Net = 15340      +/- 203
            CENTROID : 780.53
            SHAPE : Fwhm =  22.21 Channels   Fwtm =  49.88 Channels
```

NP419RTH.CHN

```
MCB # 1       ACQ 10-23-95  AT 08:45:13   RT : 100001.0    LT : 100000.0
              No detector description was entered
              channel 12 background 10/17/95

ROI # 12-1    RANGE :  231 =     4.41MeV  to  374 =     4.74MeV
              AREA : Gross = 3718      Net = 3502         +/- 92
              CENTROID : 339.91  =    4.66MeV
              SHAPE : Fwhm =   0.12MeV    Fwtm =   0.20MeV

              ID : No close library match


ROI # 12-2    RANGE :  595 =     5.26MeV  to  692 =     5.48MeV
              AREA : Gross = 997       Net = 737          +/- 69
              CENTROID : 668.94  =    5.43MeV
              SHAPE : Fwhm =   0.05MeV    Fwtm =   0.15MeV

              ID : No close library match


ROI # 12-3    RANGE :  731 =     5.57MeV  to  804 =     5.74MeV
              AREA : Gross = 664       Net = 479          +/- 51
              CENTROID : 777.41  =    5.68MeV
              SHAPE : Fwhm =   0.01MeV    Fwtm =   0.09MeV

              ID : No close library match
```

U and Th Isotope Activities

FILENAME= NP420ADU.CHN
NP420ADT.CHN

Sample # **NOPI-420-AD**
Analyst **JDP**

Sep. date **9/20/95**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.3015	1.3405	454.83	1/22/93	971	443.3372

Th-228/U-232= 0.6829223

Counting time for Th= 0 (mins.)
Days btwn. sep. and count.= 1 (days)
CF for Th-228= #DIV/0!

Counting time for U= 2580.84 (mins.)
Days btwn. sep. and count.= 11 (days)
CF for U-232= 1.0114164

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
0	0	0	0
Bkgd	Bkgd	Bkgd	bkgd
0	0	0	0
Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
0	0	#DIV/0!	0

U-238 counts	U-234 counts	U-232 counts
490	507	15156
bkgd	bkgd	bkgd
3	8	27
U-238* counts	U-234* counts	U-232sp counts
487	499	14958.232

		±	
U-238(dpm/g)=	64.17449	±	2.9456
U-234(dpm/g)=	65.75579	±	2.968761
Th-232(dpm/g)=	#DIV/0!	±	#DIV/0!
Th-230(dpm/g)=	#DIV/0!	±	#DIV/0!
U-234/U-238=	1.024641	±	0.064911
Th-230/U-234=	#DIV/0!	±	#DIV/0!
Th-230/Th-232=	#DIV/0!	±	#DIV/0!
U234/Th-232=	#DIV/0!	±	#DIV/0!

Decay constant (m-1)	U-238	Th-232
	2.948E-16	9.413E-17

U(ppb)= 86022.92

Th(ppb)= #DIV/0!

	Spike 25A 10/9/92	Spike 25B	Spide 25C
Th-228 (dpm/g)=	3030.905	302.76487	30.260557

U and Th Isotope Activities

FILENAME= NP420AMU.CHN
NP420AMT.CHN

Sample # **NOPI-420-AM**
Analyst **JDP**

Sep. date **9/20/95**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.3015	2.5996	454.83	1/22/93	971	443.3372

Th-228/U-232= 0.6829223

Counting time for Th= 2580 (mins.)
Days btwn. sep. and count.= 10 (days)
CF for Th-228= 0.9892495

Counting time for U= 2580.85 (mins.)
Days btwn. sep. and count.= 11 (days)
CF for U-232= 1.0114164

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
0	263	5569	3373

U-238 counts	U-234 counts	U-232 counts
1034	1035	19493

Bkgd	Bkgd	Bkgd	bkgd
0	12	40	130

bkgd	bkgd	bkgd
14	20	25

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
0	251	5415.3388	3243

U-238* counts	U-234* counts	U-232sp counts
1020	1015	19248.255

		±	
U-238(dpm/g)=	202.564	±	6.464357
U-234(dpm/g)=	201.571	±	6.429717
Th-232(dpm/g)=	0	±	#DIV/0!
Th-230(dpm/g)=	120.9965	±	7.635106
U-234/U-238=	0.995098	±	0.043754
Th-230/U-234=	0.600267	±	0.041451
Th-230/Th-232=	#DIV/0!	±	#DIV/0!
U234/Th-232=	#DIV/0!	±	#DIV/0!

Decay constant (m-1)	U-238	Th-232
	2.948E-16	9.413E-17

U(ppb)= 271527.6

Th(ppb)= 0

	Spike 25A 10/9/92	Spike 25B	Spide 25C
Th-228 (dpm/g)=	3030.905	302.76487	30.260557

NP420ADK.CHN

```
MCB # 1       ACQ 10-03-95  AT 14:16:57   RT : 154857.6   LT : 154850.7
              No detector description was entered
              No sample description was entered

ROI # 10-1    RANGE :   84 =     4.11MeV  to  137 =     4.24MeV
              AREA : Gross = 543        Net = 490         +/- 30
              CENTROID : 121.99  =    4.20MeV
              SHAPE : Fwhm =   0.03MeV    Fwtm =   0.10MeV

              ID : No close library match


ROI # 10-2    RANGE :  316 =     4.66MeV  to  383 =     4.81MeV
              AREA : Gross = 653        Net = 507         +/- 45
              CENTROID : 371.37  =    4.79MeV
              SHAPE : Fwhm =   0.02MeV    Fwtm =   0.07MeV

              ID : No close library match


ROI # 10-3    RANGE :  532 =     5.17MeV  to  628 =     5.39MeV
              AREA : Gross = 15883      Net = 15156       +/- 162
              CENTROID : 603.01  =    5.33MeV
              SHAPE : Fwhm =   0.05MeV    Fwtm =   0.13MeV

              ID : No close library match
```

NP420 AMT.CHN

ICB # 1		ACQ 10-03-95 AT 14:16:57 RT : 154857.7 LT : 154850.8 No detector description was entered No sample description was entered
ROI #	6-1	RANGE : 299 = 4.57MeV to 351 = 4.71MeV AREA : Gross = 343 Net = 263 +/- 30 CENTROID : 338.27 = 4.67MeV SHAPE : Fwhm = 0.01MeV Fwtm = 0.11MeV ID : No close library match
ROI #	6-2	RANGE : 552 = 5.26MeV to 619 = 5.45MeV AREA : Gross = 7949 Net = 5569 +/- 174 CENTROID : 601.48 = 5.40MeV SHAPE : Fwhm = 0.05MeV Fwtm = 0.14MeV ID : No close library match
ROI #	6-3	RANGE : 634 = 5.49MeV to 714 = 5.71MeV AREA : Gross = 4291 Net = 3373 +/- 122 CENTROID : 690.67 = 5.64MeV SHAPE : Fwhm = 0.09MeV Fwtm = 0.17MeV ID : No close library match

NP420 AMU.CHW

```
MCB # 1         ACQ 10-03-95  AT 14:16:58   RT : 154857.4   LT : 154850.5
                No detector description was entered
                No sample description was entered

ROI # 13-1      RANGE :    73 =     4.08MeV  to  140 =     4.23MeV
                AREA : Gross = 1239       Net = 1034       +/- 56
                CENTROID : 124.34  =    4.20MeV
                SHAPE : Fwhm =   0.03MeV    Fwtm =   0.11MeV

                ID : No close library match

ROI # 13-2      RANGE :   315 =     4.64MeV  to  390 =     4.81MeV
                AREA : Gross = 1339       Net = 1035       +/- 68
                CENTROID : 368.81  =    4.76MeV
                SHAPE : Fwhm =   0.05MeV    Fwtm =   0.11MeV

                ID : No close library match

ROI # 13-3      RANGE :   529 =     5.14MeV  to  627 =     5.36MeV
                AREA : Gross = 20288      Net = 19493      +/- 178
                CENTROID : 604.33  =    5.31MeV
                SHAPE : Fwhm =   0.08MeV    Fwtm =   0.13MeV

                ID : No close library match
```

U and Th Isotope Activities

FILENAME= NP421IEU.CHN
NP421IET.CHN

Sample # **NOPI-421-IE**
Analyst **JDP**

Sep. date **8/17/95**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.3882	1.5633	45.459	1/22/93	937	44.35005

Th-228/U-232= 0.6698417

Counting time for Th=	0	(mins.)	
Days btwn. sep. and count.=	9	(days)	
CF for Th-228=	#DIV/0!		

Counting time for U=	5927.1	(mins.)	
Days btwn. sep. and count.=	9	(days)	
CF for U-232=	1.0106161		

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
0	0	0	0

U-238 counts	U-234 counts	U-232 counts
1268	1043	12850

Bkgd	Bkgd	Bkgd	bkgd
0	0	0	0

bkgd	bkgd	bkgd
5	5	35

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
0	0	#DIV/0!	0

U-238* counts	U-234* counts	U-232sp counts
1263	1038	12680.384

		±	
U-238(dpm/g)=	17.78902	±	0.523633
U-234(dpm/g)=	14.61995	±	0.470707
Th-232(dpm/g)=	#DIV/0!	±	#DIV/0!
Th-230(dpm/g)=	#DIV/0!	±	#DIV/0!
U-234/U-238=	0.821853	±	0.034355
Th-230/U-234=	#DIV/0!	±	#DIV/0!
Th-230/Th-232=	#DIV/0!	±	#DIV/0!
U234/Th-232=	#DIV/0!	±	#DIV/0!

Decay constant (m-1)	U-238	Th-232
	2.948E-16	9.413E-17

U(ppb)= 23845.35

Th(ppb)= #DIV/0!

	Spike 25A 10/9/92	Spike 25B	Spide 25C
Th-228 (dpm/g)=	2975.5122	297.23154	29.707515

U and Th Isotope Activities

FILENAME= NP421ADU.CHN
NP421ADT.CHN

Sample # **NOPI-421-AD**
Analyst **JDP**

Sep. date **8/10/95**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.3882	1.5747	45.459	1/22/93	930	44.35824

Th-228/U-232= 0.6671

Counting time for Th=	6018.7	(mins.)
Days btwn. sep. and count.=	15	(days)
CF for Th-228=	0.9831902	

Counting time for U=	5927.1	(mins.)
Days btwn. sep. and count.=	15	(days)
CF for U-232=	1.0163255	

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
0	3102	5785	5033

U-238 counts	U-234 counts	U-232 counts
2688	3499	4510

Bkgd	Bkgd	Bkgd	bkgd
0	13	20	20

bkgd	bkgd	bkgd
3	9	25

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
0	3089	5593.334	5013

U-238* counts	U-234* counts	U-232sp counts
2685	3490	4412.9561

		±	
U-238(dpm/g)=	109.4791	±	2.667683
U-234(dpm/g)=	142.3025	±	3.205836
Th-232(dpm/g)=	0	±	#DIV/0!
Th-230(dpm/g)=	66.29102	±	1.47523
U-234/U-238=	1.299814	±	0.033338
Th-230/U-234=	0.465846	±	0.011488
Th-230/Th-232=	#DIV/0!	±	#DIV/0!
U234/Th-232=	#DIV/0!	±	#DIV/0!

Decay constant (m-1)	U-238	Th-232
	2.948E-16	9.413E-17

U(ppb)= 146751.7

Th(ppb)= 0

	Spike 25A 10/9/92	Spike 25B	Spide 25C
Th-228 (dpm/g)=	2963.8804	296.06961	29.591382

U and Th Isotope Activities

FILENAME= NP421AMU.CHN
NP421AMT.CHN

Sample # **NOPI-421-AM**
Analyst **JDP**

Sep. date **8/19/95**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.3882	0.3974	454.83	1/22/93	939	443.7113

Th-228/U-232= 0.6706209

Counting time for Th=	8559.4	(mins.)	Counting time for U=	5927.1	(mins.)
Days btwn. sep. and count.=	11	(days)	Days btwn. sep. and count.=	11	(days)
CF for Th-228=	0.9862365		CF for U-232=	1.0125232	

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
0	1685	3121	2932
Bkgd	Bkgd	Bkgd	bkgd
0	3	58	60

U-238 counts	U-234 counts	U-232 counts
812	1068	8147
bkgd	bkgd	bkgd
7	16	37

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
0	1682	2951.4056	2872

U-238* counts	U-234* counts	U-232sp counts
805	1052	8009.6927

U-238(dpm/g)=	45.65127	±	1.679986
U-234(dpm/g)=	59.65855	±	1.941493
Th-232(dpm/g)=	0	±	#DIV/0!
Th-230(dpm/g)=	173.5989	±	5.247979
U-234/U-238=	1.306832	±	0.060846
Th-230/U-234=	2.909875	±	0.113813
Th-230/Th-232=	#DIV/0!	±	#DIV/0!
U234/Th-232=	#DIV/0!	±	#DIV/0!

Decay constant (m-1)	U-238	Th-232
	2.948E-16	9.413E-17

U(ppb)= 61193.41

Th(ppb)= 0

	Spike 25A 10/9/92	Spike 25B	Spide 25C
Th-228 (dpm/g)=	2978.8212	297.56208	29.740552

U and Th Isotope Activities

FILENAME= NP421CRU.CHN
NP421CRT.CHN

Sample # **NOPI-421-CR**
Analyst **JDP**

Sep. date **9/11/95**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.3882	0.8101	454.83	1/22/93	962	443.4424

Th-228/U-232= 0.6794971

Counting time for Th= 11695.2 (mins.)
Days btwn. sep. and count.= 24 (days)
CF for Th-228= 0.9725496

Counting time for U= 11692.9 (mins.)
Days btwn. sep. and count.= 24 (days)
CF for U-232= 1.0267

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
0	115979	42942	29966

U-238 counts	U-234 counts	U-232 counts
31286	34117	40074

Bkgd	Bkgd	Bkgd	bkgd
0	50	50	80

bkgd	bkgd	bkgd
11	25	40

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
0	115929	42473.969	29886

U-238* counts	U-234* counts	U-232sp counts
31275	34092	38992.888

U-238(dpm/g)=	742.2193	±	5.599552
U-234(dpm/g)=	809.0724	±	5.96
Th-232(dpm/g)=	0	±	#DIV/0!
Th-230(dpm/g)=	1716.236	±	9.694758
U-234/U-238=	1.090072	±	0.008533
Th-230/U-234=	2.12124	±	0.013065
Th-230/Th-232=	#DIV/0!	±	#DIV/0!
U234/Th-232=	#DIV/0!	±	#DIV/0!

Decay constant (m-1)	U-238	Th-232
	2.948E-16	9.413E-17

U(ppb)= 994910.5

Th(ppb)= 0

	Spike 25A 10/9/92	Spike 25B	Spide 25C
Th-228 (dpm/g)=	3016.4187	301.3178	30.115925

NP421IEU.CHN

```
MCB # 1      ACQ 09-01-95  AT 10:09:16   RT : 355632.6   LT : 355625.8
             No detector description was entered
             NOPI 421 U count IE phase-channel 7-9/5/95

ROI #  7-1   RANGE :   70 to  147
             AREA : Gross = 1424      Net = 1268       +/- 56
             CENTROID : 116.72
             SHAPE : Fwhm =  20.90 Channels   Fwtm =  60.92 Channels

ROI #  7-2   RANGE :  300 to  397
             AREA : Gross = 1313      Net = 1043       +/- 72
             CENTROID : 358.21
             SHAPE : Fwhm =  38.58 Channels   Fwtm =  67.79 Channels

ROI #  7-3   RANGE :  517 to  635
             AREA : Gross = 13826     Net = 12850      +/- 177
             CENTROID : 601.00
             SHAPE : Fwhm =  45.45 Channels   Fwtm =  76.75 Channels
```

NP421ADU.CHN

MCB # 1	ACQ 09-01-95 AT 10:09:16	RT : 355632.4	LT : 355625.7	
	No detector description was entered			
	No sample description was entered			

```
ROI #  9-1    RANGE :    67 to  156
              AREA : Gross = 2945      Net = 2688       +/- 79
              CENTROID : 127.75
              SHAPE : Fwhm =  39.40 Channels   Fwtm =  67.43 Channels

ROI #  9-2    RANGE :   318 to  404
              AREA : Gross = 3978      Net = 3499       +/- 100
              CENTROID : 374.39
              SHAPE : Fwhm =  39.21 Channels   Fwtm =  66.77 Channels

ROI #  9-3    RANGE :   530 to  641
              AREA : Gross = 4981      Net = 4510       +/- 113
              CENTROID : 610.53
              SHAPE : Fwhm =  43.07 Channels   Fwtm =  71.01 Channels
```

NP421ADT.CHN

```
MC    1        ACQ 09-01-95  AT 10:09:17   RT : 361128.6   LT : 361121.7
               No detector description was entered
               No sample description was entered

ROI # 15-1     RANGE :  271 to  356
               AREA : Gross = 3489      Net = 3102       +/- 91
               CENTROID : 333.29
               SHAPE : Fwhm =  24.94 Channels   Fwtm =  57.69 Channels

ROI # 15-2     RANGE :  597 to  681
               AREA : Gross = 7541      Net = 5785       +/- 170
               CENTROID : 653.59
               SHAPE : Fwhm =  20.99 Channels   Fwtm =  61.65 Channels

ROI # 15-3     RANGE :  698 to  791
               AREA : Gross = 7258      Net = 5033       +/- 194
               CENTROID : 764.40
               SHAPE : Fwhm =  24.71 Channels   Fwtm =  72.92 Channels
```

NP421AMU.CHN

```
MCB # 1       ACQ 09-01-95  AT 10:09:16   RT : 355632.3   LT : 355625.6
              No detector description was entered
              No sample description was entered

ROI # 11-1    RANGE :   86 to  157
              AREA : Gross = 1053      Net = 812        +/- 59
              CENTROID : 140.82
              SHAPE : Fwhm =  27.58 Channels   Fwtm =  55.07 Channels


ROI # 11-2    RANGE :  330 to  404
              AREA : Gross = 1383      Net = 1068       +/- 68
              CENTROID : 384.23
              SHAPE : Fwhm =  33.48 Channels   Fwtm =  59.04 Channels


ROI # 11-3    RANGE :  561 to  646
              AREA : Gross = 9666      Net = 8147       +/- 169
              CENTROID : 618.77
              SHAPE : Fwhm =  44.35 Channels   Fwtm =  65.47 Channels
```

NP421 ~~ATH~~ AMT.chN

MCB 1 ACQ 09-12-95 AT 10:37:31 RT : 513593.6 LT : 513565.4
No detector description was entered
NOPI 421 Th count AM phase-channel 7 9/16/95

ROI # 7-1 RANGE : 279 to 357
AREA : Gross = 2662 Net = 1685 +/- 116
CENTROID : 340.44
SHAPE : Fwhm = 20.64 Channels Fwtm = 56.39 Channels

ROI # 7-2 RANGE : 588 to 681
AREA : Gross = 4249 Net = 3121 +/- 140
CENTROID : 659.60
SHAPE : Fwhm = 19.74 Channels Fwtm = 73.01 Channels

ROI # 7-3 RANGE : 701 to 792
AREA : Gross = 4280 Net = 2932 +/- 149
CENTROID : 769.96
SHAPE : Fwhm = 35.28 Channels Fwtm = 66.36 Channels

WP421CRU.CHN

```
MCB # 1       ACQ 10-05-95  AT 10:30:30   RT : 701681.3   LT : 701576.6
              No detector description was entered
              NOPI-421 U crystalline

ROI # 12-1    RANGE :   50 =    3.99MeV  to  164 =    4.26MeV
              AREA : Gross = 33299     Net = 31286      +/- 260
              CENTROID : 129.87  =    4.18MeV
              SHAPE : Fwhm =   0.09MeV    Fwtm =   0.16MeV

              ID : No close library match


ROI # 12-2    RANGE :  293 =    4.55MeV  to  413 =    4.83MeV
              AREA : Gross = 35951     Net = 34117      +/- 263
              CENTROID : 380.19  =    4.76MeV
              SHAPE : Fwhm =   0.10MeV    Fwtm =   0.17MeV

              ID : No close library match


ROI # 12-3    RANGE :  542 =    5.13MeV  to  650 =    5.38MeV
              AREA : Gross = 42090     Net = 40074      +/- 273
              CENTROID : 617.68  =    5.31MeV
              SHAPE : Fwhm =   0.10MeV    Fwtm =   0.17MeV

              ID : No close library match
```

NP421cRT.CHW

```
MCB # 1       ACQ 10-05-95  AT 10:30:30   RT : 701817.1   LT : 701712.4
              No detector description was entered
              NOPI-421 Th crystalline

ROI # 16-1    RANGE :  201 =    4.35MeV  to  374 =    4.75MeV
              AREA : Gross = 119372    Net = 115979    +/- 459
              CENTROID : 341.42  =    4.67MeV
              SHAPE : Fwhm =   0.12MeV    Fwtm =   0.20MeV

              ID : No close library match


ROI # 16-2    RANGE :  578 =    5.21MeV  to  697 =    5.48MeV
              AREA : Gross = 49902     Net = 42942      +/- 419
              CENTROID : 669.32  =    5.42MeV
              SHAPE : Fwhm =   0.07MeV    Fwtm =   0.18MeV

              ID : No close library match


ROI # 16-3    RANGE :  714 =    5.52MeV  to  811 =    5.74MeV
              AREA : Gross = 35956     Net = 29966      +/- 349
              CENTROID : 783.11  =    5.68MeV
              SHAPE : Fwhm =   0.07MeV    Fwtm =   0.15MeV

              ID : No close library match
```

U and Th Isotope Activities

FILENAME= NP422IEU.CHN
NP422IET.CHN

Sample # **NOPI-422-IE**
Analyst **JDP**

Sep. date 8/9/95

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.4787	1.5137	45.459	1/22/93	929	44.35941

Th-228/U-232= 0.666707

Counting time for Th= 0 (mins.)
Days btwn. sep. and count.= 1 (days)
CF for Th-228= #DIV/0!

Counting time for U= 5927.1 (mins.)
Days btwn. sep. and count.= 16 (days)
CF for U-232= 1.0172736

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
0	0	0	0

U-238 counts	U-234 counts	U-232 counts
3596	4021	8637

Bkgd	Bkgd	Bkgd	bkgd
0	0	0	0

bkgd	bkgd	bkgd
3	6	10

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
0	0	#DIV/0!	0

U-238* counts	U-234* counts	U-232sp counts
3593	4015	8480.5108

U-238(dpm/g)=	59.42885	±	1.179431
U-234(dpm/g)=	66.4088	±	1.267826
Th-232(dpm/g)=	#DIV/0!	±	#DIV/0!
Th-230(dpm/g)=	#DIV/0!	±	#DIV/0!
U-234/U-238=	1.117451	±	0.025647
Th-230/U-234=	#DIV/0!	±	#DIV/0!
Th-230/Th-232=	#DIV/0!	±	#DIV/0!
U234/Th-232=	#DIV/0!	±	#DIV/0!

Decay constant (m-1)	U-238	Th-232
	2.948E-16	9.413E-17

U(ppb)= 79661.61

Th(ppb)= #DIV/0!

	Spike 25A 10/9/92	Spike 25B	Spide 25C
Th-228 (dpm/g)=	2962.2122	295.90297	29.574728

U and Th Isotope Activities

FILENAME= NP422ADU.CHN
NP422ADT.CHN

Sample # **NOPI-422-AD**
Analyst **JDP**

Sep. date **8/10/95**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.4787	1.5137	45.459	1/22/93	930	44.35824

Th-228/U-232= 0.6671

Counting time for Th=	6018	(mins.)
Days btwn. sep. and count.=	15	(days)
CF for Th-228=	0.9831904	

Counting time for U=	6018.7	(mins.)
Days btwn. sep. and count.=	15	(days)
CF for U-232=	1.0163557	

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
0	3771	7513	4299

U-238 counts	U-234 counts	U-232 counts
301	210	348

Bkgd	Bkgd	Bkgd	bkgd
0	32	50	90

bkgd	bkgd	bkgd
6	8	35

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
0	3739	7363.7039	4209

U-238* counts	U-234* counts	U-232sp counts
295	202	307.96305

		±	
U-238(dpm/g)=	134.3613	±	10.57605
U-234(dpm/g)=	92.0033	±	8.039356
Th-232(dpm/g)=	0	±	#DIV/0!
Th-230(dpm/g)=	47.51172	±	0.948194
U-234/U-238=	0.684746	±	0.061567
Th-230/U-234=	0.516413	±	0.036615
Th-230/Th-232=	#DIV/0!	±	#DIV/0!
U234/Th-232=	#DIV/0!	±	#DIV/0!

Decay constant (m-1)	U-238	Th-232
	2.948E-16	9.413E-17

U(ppb)= 180105

Th(ppb)= 0

	Spike 25A 10/9/92	Spike 25B	Spide 25C
Th-228 (dpm/g)=	2963.8804	296.06961	29.591382

U and Th Isotope Activities

FILENAME= NP422AMU.CHN
NP422AMT.CHN

Sample # **NOPI-422-AM**
Analyst **JDP**

Sep. date **8/11/95**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.4787	0.4021	454.83	1/22/93	931	443.8049

Th-228/U-232= 0.6674917

Counting time for Th= 8559.42 (mins.)
Days btwn. sep. and count.= 7 (days)
CF for Th-228= 0.9901578

Counting time for U= 10128.6 (mins.)
Days btwn. sep. and count.= 7 (days)
CF for U-232= 1.0100981

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
0	3051	3382	3436
Bkgd	Bkgd	Bkgd	bkgd
0	5	20	13

U-238 counts	U-234 counts	U-232 counts
4350	5323	31075
bkgd	bkgd	bkgd
7	15	33

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
0	3046	3212.1962	3423

U-238* counts	U-234* counts	U-232sp counts
4343	5308	30731.67

U-238(dpm/g)=	52.6825	±	0.852847
U-234(dpm/g)=	64.38837	±	0.95513
Th-232(dpm/g)=	0	±	#DIV/0!
Th-230(dpm/g)=	235.9589	±	5.891628
U-234/U-238=	1.222197	±	0.02498
Th-230/U-234=	3.66462	±	0.083214
Th-230/Th-232=	#DIV/0!	±	#DIV/0!
U234/Th-232=	#DIV/0!	±	#DIV/0!

Decay constant (m-1)	U-238	Th-232
	2.948E-16	9.413E-17

U(ppb)= 70618.45

Th(ppb)= 0

	Spike 25A	Spike 25B	Spide 25C
	10/9/92		
Th-228 (dpm/g)=	2965.5469	296.23608	29.608021

U and Th Isotope Activities

FILENAME= NP422CRU.CHN
NP422CRT.CHN

Sample # **NOPI-422-CR**
Analyst **JDP**

Sep. date 9/23/95

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.4787	0.8071	454.83	1/22/93	974	443.3022

Th-228/U-232= 0.6840581

Counting time for Th=	11695.8	(mins.)	Counting time for U=	11693.5	(mins.)
Days btwn. sep. and count.=	9	(days)	Days btwn. sep. and count.=	9	(days)
CF for Th-228=	0.9871294		CF for U-232=	1.0125233	

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
0	276453	151912	104037
Bkgd	Bkgd	Bkgd	bkgd
0	25	60	300

U-238 counts	U-234 counts	U-232 counts
27690	34417	42015
bkgd	bkgd	bkgd
30	30	28

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
0	276428	148262.16	103737

U-238* counts	U-234* counts	U-232sp counts
27660	34387	41467.687

U-238(dpm/g)=	498.547	±	3.858997
U-234(dpm/g)=	619.7952	±	4.506062
Th-232(dpm/g)=	0	±	#DIV/0!
Th-230(dpm/g)=	953.2537	±	3.04445
U-234/U-238=	1.243203	±	0.010036
Th-230/U-234=	1.538014	±	0.008791
Th-230/Th-232=	#DIV/0!	±	#DIV/0!
U234/Th-232=	#DIV/0!	±	#DIV/0!

Decay constant (m-1)	U-238	Th-232
	2.948E-16	9.413E-17

U(ppb)= 668279.2

Th(ppb)= 0

	Spike 25A 10/9/92	Spike 25B	Spide 25C
Th-228 (dpm/g)=	3035.7059	303.24444	30.308488

U and Th Isotope Activities

FILENAME= NP422REU.CHN
NP422RET.CHN

Sample # **NOPI-422-RES**
Analyst **JDP**

Sep. date 9/20/95

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.4787	0.8401	45.459	1/22/93	971	44.31033

Th-228/U-232= 0.6829233

Counting time for Th=	0	(mins.)
Days btwn. sep. and count.=	15	(days)
CF for Th-228=	#DIV/0!	

Counting time for U=	1666.67	(mins.)
Days btwn. sep. and count.=	21	(days)
CF for U-232=	1.0206043	

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
0	0	0	0
Bkgd	Bkgd	Bkgd	bkgd
0	0	0	0
Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
0	0	#DIV/0!	0

U-238 counts	U-234 counts	U-232 counts
1675	1734	592
bkgd	bkgd	bkgd
3	6	10
U-238* counts	U-234* counts	U-232sp counts
1672	1728	570.25038

		±	
U-238(dpm/g)=	228.0044	±	10.90186
U-234(dpm/g)=	235.6409	±	11.21683
Th-232(dpm/g)=	#DIV/0!	±	#DIV/0!
Th-230(dpm/g)=	#DIV/0!	±	#DIV/0!
U-234/U-238=	1.033493	±	0.035407
Th-230/U-234=	#DIV/0!	±	#DIV/0!
Th-230/Th-232=	#DIV/0!	±	#DIV/0!
U234/Th-232=	#DIV/0!	±	#DIV/0!

Decay constant (m-1)	U-238	Th-232
	2.948E-16	9.413E-17

U(ppb)= 305629.3

Th(ppb)= #DIV/0!

	Spike 25A 10/9/92	Spike 25B	Spide 25C
Th-228 (dpm/g)=	3030.905	302.76487	30.260557

NP422IEU.CHN

```
MCB # 1     ACQ 09-01-95  AT 10:09:16   RT : 355632.5   LT : 355625.8
            No detector description was entered
            No sample description was entered

ROI #  8-1  RANGE :   71 to  147
            AREA : Gross = 4328      Net = 3596       +/- 111
            CENTROID : 121.81
            SHAPE : Fwhm =  35.29 Channels   Fwtm =  60.25 Channels


ROI #  8-2  RANGE :  318 to  399
            AREA : Gross = 4964      Net = 4021       +/- 126
            CENTROID : 371.41
            SHAPE : Fwhm =  36.58 Channels   Fwtm =  64.08 Channels


ROI #  8-3  RANGE :  551 to  638
            AREA : Gross = 9649      Net = 8637       +/- 150
            CENTROID : 607.09
            SHAPE : Fwhm =  38.84 Channels   Fwtm =  65.28 Channels
```

VP422ADU.CHN

```
MCB # 1      ACQ 09-01-95  AT 10:09:16   RT : 361128.9   LT : 361122.0
             No detector description was entered
             No sample description was entered

ROI # 10-1   RANGE :   65 to  135
             AREA : Gross = 301        Net = 301        +/- 17
             CENTROID : 118.92
             SHAPE : Fwhm =  13.36 Channels   Fwtm =  31.87 Channels

ROI # 10-2   RANGE :  310 to  395
             AREA : Gross = 279        Net = 210        +/- 34
             Could not properly fit the peak.

ROI # 10-3   RANGE :  546 to  632
             AREA : Gross = 509        Net = 348        +/- 50
             CENTROID : 599.53
             SHAPE : Fwhm =   2.70 Channels   Fwtm =  39.60 Channels
```

NP422 Adt.CHN

```
MCB # 1      ACQ 09-01-95  AT 10:09:17   RT : 361128.5   LT : 361121.6
             No detector description was entered
             No sample description was entered

ROI # 16-1   RANGE :  267 to  367
             AREA : Gross = 4444      Net = 3771       +/- 120
             CENTROID : 341.94
             SHAPE : Fwhm =  35.40 Channels   Fwtm =  73.48 Channels


ROI # 16-2   RANGE :  574 to  688
             AREA : Gross = 9123      Net = 7513       +/- 192
             CENTROID : 664.78
             SHAPE : Fwhm =  31.58 Channels   Fwtm =  80.28 Channels


ROI # 16-3   RANGE :  705 to  801
             AREA : Gross = 5835      Net = 4299       +/- 166
             CENTROID : 776.29
             SHAPE : Fwhm =  33.76 Channels   Fwtm =  78.79 Channels
```

NP422RES.CHN
4

```
CB # 1       ACQ 10-23-95  AT 08:45:12   RT : 100001.0   LT : 100000.0
             No detector description was entered
             channel 8 background 10/17/95

OI #  8-1    RANGE :   80 =    4.08MeV  to  152 =    4.24MeV
             AREA : Gross = 1794      Net = 1675       +/- 55
             CENTROID : 131.48  =    4.20MeV
             SHAPE : Fwhm =   0.06MeV    Fwtm =   0.12MeV

             ID : No close library match


OI #  8-2    RANGE :  333 =    4.66MeV  to  404 =    4.83MeV
             AREA : Gross = 1903      Net = 1734       +/- 60
             CENTROID : 382.56  =    4.78MeV
             SHAPE : Fwhm =   0.04MeV    Fwtm =   0.14MeV

             ID : No close library match


OI #  8-3    RANGE :  577 =    5.23MeV  to  643 =    5.39MeV
             AREA : Gross = 704       Net = 592        +/- 42
             CENTROID : 621.68  =    5.34MeV
             SHAPE : Fwhm =   0.03MeV    Fwtm =   0.12MeV

             ID : No close library match
```

NP422AMU.CHN

MCB # 1	ACQ 09-18-95 AT 10:49:34 RT : 607721.5 LT : 607716.6 No detector description was entered NOPI 425 U count IE phase-channel 9-9/25/95	
ROI # 12-1	RANGE : 63 to 152 AREA : Gross = 5056 Net = 4350 +/- 119 CENTROID : 123.72 SHAPE : Fwhm = 35.57 Channels Fwtm = 71.74 Channels	
ROI # 12-2	RANGE : 311 to 404 AREA : Gross = 6451 Net = 5323 +/- 148 CENTROID : 371.52 SHAPE : Fwhm = 44.25 Channels Fwtm = 71.19 Channels	
ROI # 12-3	RANGE : 523 to 647 AREA : Gross = 33408 Net = 31075 +/- 278 CENTROID : 608.30 SHAPE : Fwhm = 45.75 Channels Fwtm = 75.23 Channels	

NP422AMT.CHN

```
MCB # 1       ACQ 09-12-95  AT 10:37:32   RT : 513593.4   LT : 513565.3
              No detector description was entered
              No sample description was entered

ROI #  8-1    RANGE :  264 to  360
              AREA : Gross = 3958      Net = 3051        +/- 130
              CENTROID : 338.26
              SHAPE : Fwhm =  19.84 Channels   Fwtm =  64.50 Channels


ROI #  8-2    RANGE :  605 to  685
              AREA : Gross = 4759      Net = 3382        +/- 144
              CENTROID : 661.56
              SHAPE : Fwhm =  22.68 Channels   Fwtm =  63.05 Channels


ROI #  8-3    RANGE :  707 to  795
              AREA : Gross = 4548      Net = 3436        +/- 137
              CENTROID : 772.90
              SHAPE : Fwhm =  27.60 Channels   Fwtm =  60.83 Channels
```

NP422CRU.CHN

```
MCB # 1        ACQ 10-05-95  AT 10:30:30   RT : 701714.7   LT : 701610.0
               No detector description was entered
               NOPI-422 U crystalline

ROI # 13-1     RANGE :   52 =    4.03MeV  to  152 =    4.26MeV
               AREA : Gross = 29845     Net = 27690      +/- 249
               CENTROID : 123.24  =    4.19MeV
               SHAPE : Fwhm =   0.08MeV    Fwtm =   0.15MeV

               ID : No close library match


ROI # 13-2     RANGE :  314 =    4.64MeV  to  401 =    4.84MeV
               AREA : Gross = 37849     Net = 34417      +/- 285
               CENTROID : 372.28  =    4.77MeV
               SHAPE : Fwhm =   0.08MeV    Fwtm =   0.15MeV

               ID : No close library match


ROI # 13-3     RANGE :  539 =    5.16MeV  to  640 =    5.39MeV
               AREA : Gross = 44871     Net = 42015      +/- 296
               CENTROID : 611.24  =    5.33MeV
               SHAPE : Fwhm =   0.10MeV    Fwtm =   0.16MeV

               ID : No close library match
```

NP422 CRT.CHN

MC[illegible] 1 ACQ 10-05-95 AT 10:30:29 RT : 701852.5 LT : 701747.8
No detector description was entered
NOPI-422 Th crystalline

ROI # 5-1 RANGE : 212 = 4.29MeV to 382 = 4.72MeV
AREA : Gross = 287311 Net = 276453 +/- 758
CENTROID : 359.13 = 4.66MeV
SHAPE : Fwhm = 0.12MeV Fwtm = 0.23MeV

ID : No close library match

ROI # 5-2 RANGE : 564 = 5.18MeV to 678 = 5.47MeV
AREA : Gross = 180835 Net = 151912 +/- 823
CENTROID : 653.56 = 5.41MeV
SHAPE : Fwhm = 0.08MeV Fwtm = 0.19MeV

ID : No close library match

ROI # 5-3 RANGE : 690 = 5.50MeV to 783 = 5.73MeV
AREA : Gross = 123949 Net = 104037 +/- 629
CENTROID : 756.93 = 5.67MeV
SHAPE : Fwhm = 0.07MeV Fwtm = 0.16MeV

ID : No close library match

U and Th Isotope Activities

FILENAME= NP423ADU.CHN
NP423ADT.CHN

Sample # **NOPI-423-AD**
Analyst **JDP**

Sep. date **6/13/95**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.4459	0.3185	45.459	1/22/93	872	44.4261

Th-228/U-232= 0.6437284

Counting time for Th=	0	(mins.)
Days btwn. sep. and count.=	1	(days)
CF for Th-228=	#DIV/0!	

Counting time for U=	4342.1	(mins.)
Days btwn. sep. and count.=	12	(days)
CF for U-232=	1.0129518	

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
0	0	0	0

U-238 counts	U-234 counts	U-232 counts
2770	3342	1770

Bkgd	Bkgd	Bkgd	bkgd
0	0	0	0

bkgd	bkgd	bkgd
3	6	10

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
0	0	#DIV/0!	0

U-238* counts	U-234* counts	U-232sp counts
2767	3336	1737.4963

		±	
U-238(dpm/g)=	50.53537	±	1.537789
U-234(dpm/g)=	60.92735	±	1.791092
Th-232(dpm/g)=	#DIV/0!	±	#DIV/0!
Th-230(dpm/g)=	#DIV/0!	±	#DIV/0!
U-234/U-238=	1.205638	±	0.030979
Th-230/U-234=	#DIV/0!	±	#DIV/0!
Th-230/Th-232=	#DIV/0!	±	#DIV/0!
U234/Th-232=	#DIV/0!	±	#DIV/0!

Decay constant (m-1)	U-238	Th-232
	2.948E-16	9.413E-17

U(ppb)= 67740.32

Th(ppb)= #DIV/0!

	Spike 25A 10/9/92	Spike 25B	Spide 25C
Th-228 (dpm/g)=	2864.4173	286.13398	28.598343

U and Th Isotope Activities

FILENAME= NP423CRU.CHN
NP423CRT.CHN

Sample # **NOPI-423-CR**
Analyst **JDP**

Sep. date 6/15/95

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.4459	1.1208	45.459	1/22/93	874	44.42376

Th-228/U-232= 0.6445542

Counting time for Th=	0	(mins.)	Counting time for U=	10241.3	(mins.)
Days btwn. sep. and count.=	1	(days)	Days btwn. sep. and count.=	6	(days)
CF for Th-228=	#DIV/0!		CF for U-232=	1.0091798	

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
0	0	0	0

U-238 counts	U-234 counts	U-232 counts
570	717	1018

Bkgd	Bkgd	Bkgd	bkgd
0	0	0	0

bkgd	bkgd	bkgd
8	17	30

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
0	0	#DIV/0!	0

U-238* counts	U-234* counts	U-232sp counts
562	700	979.01284

U-238(dpm/g)=	64.09939	±	3.353265
U-234(dpm/g)=	79.8391	±	3.892529
Th-232(dpm/g)=	#DIV/0!	±	#DIV/0!
Th-230(dpm/g)=	#DIV/0!	±	#DIV/0!
U-234/U-238=	1.245552	±	0.069896
Th-230/U-234=	#DIV/0!	±	#DIV/0!
Th-230/Th-232=	#DIV/0!	±	#DIV/0!
U234/Th-232=	#DIV/0!	±	#DIV/0!

Decay constant (m-1)	U-238	Th-232
	2.948E-16	9.413E-17

U(ppb)= 85922.26

Th(ppb)= #DIV/0!

	Spike 25A	Spike 25B	Spide 25C
	10/9/92		
Th-228 (dpm/g)=	2867.9406	286.48593	28.633519

U and Th Isotope Activities

FILENAME= NP423REU.CHN
NP423RET.CHN

Sample # **NOPI-423-RES**
Analyst **JDP**

Sep. date **6/28/95**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.4459	0.1507	45.459	1/22/93	887	44.40854

Th-228/U-232= 0.6498867

Counting time for Th= 2845 (mins.)
Days btwn. sep. and count.= 17 (days)
CF for Th-228= 0.9823141

Counting time for U= 2845 (mins.)
Days btwn. sep. and count.= 17 (days)
CF for U-232= 1.0172077

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
87	3738	1025	491
Bkgd	Bkgd	Bkgd	bkgd
20	45	20	25

U-238 counts	U-234 counts	U-232 counts
3468	3310	1470
bkgd	bkgd	bkgd
5	9	28

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
67	3693	930.95165	466

U-238* counts	U-234* counts	U-232sp counts
3463	3301	1417.6063

		±	
U-238(dpm/g)=	36.66394	±	1.141081
U-234(dpm/g)=	34.94879	±	1.095402
Th-232(dpm/g)=	0.701985	±	0.07839
Th-230(dpm/g)=	38.69297	±	1.36424
U-234/U-238=	0.95322	±	0.023163
Th-230/U-234=	1.107133	±	0.026424
Th-230/Th-232=	55.1194	±	5.977794
U234/Th-232=	49.7857	±	5.774336

Decay constant (m-1)	U-238	Th-232
	2.948E-16	9.413E-17

U(ppb)= 49146.31

Th(ppb)= 2872.958

	Spike 25A 10/9/92	Spike 25B	Spide 25C
Th-228 (dpm/g)=	2890.6768	288.75711	28.860518

NP423IE4.CHN
bad resolution
+ interference.

Dont use

MC 1 ACQ 07-03-95 AT 08:48:09 RT : 614480.0 LT : 614479.1
No detector description was entered
No sample description was entered

ROI # 9-1 RANGE : 97 to 151
AREA : Gross = 123 Net = 122 +/- 11
CENTROID : 122.00
SHAPE : Fwhm = 1.13 Channels Fwtm = 29.10 Channels

ROI # 9-2 RANGE : 310 to 369
AREA : Gross = 165 Net = 24 +/- 36
Could not properly fit the peak.

ROI # 9-3 RANGE : 576 to 643
AREA : Gross = 3427 Net = 2384 +/- 115
CENTROID : 620.31
SHAPE : Fwhm = 21.46 Channels Fwtm = 49.09 Channels

NP423ADU.CHN

```
MC  1      ACQ 07-10-95  AT 12:04:16   RT : 260527.6   LT : 260525.2
           No detector description was entered
           No sample description was entered

ROI # 8-1  RANGE :   81 to  153
           AREA : Gross = 3099      Net = 2770       +/- 80
           CENTROID : 128.58
           SHAPE : Fwhm =  28.17 Channels   Fwtm =  51.33 Channels


ROI # 8-2  RANGE :  329 to  401
           AREA : Gross = 3780      Net = 3342       +/- 91
           CENTROID : 378.68
           SHAPE : Fwhm =  24.79 Channels   Fwtm =  56.39 Channels


ROI # 8-3  RANGE :  566 to  637
           AREA : Gross = 2069      Net = 1770       +/- 71
           CENTROID : 615.92
           SHAPE : Fwhm =  23.82 Channels   Fwtm =  52.35 Channels
```

NP423CRU.CHN

```
MCB # 1       ACQ 07-03-95  AT 08:48:11   RT : 614478.4   LT : 614477.5
              No detector description was entered
              No sample description was entered

ROI # 11-1    RANGE :   92 to  159
              AREA : Gross = 685      Net = 570        +/- 42
              CENTROID : 139.65
              SHAPE : Fwhm =  15.56 Channels   Fwtm =  44.78 Channels


ROI # 11-2    RANGE :  347 to  407
              AREA : Gross = 900      Net = 717        +/- 49
              CENTROID : 385.57
              SHAPE : Fwhm =  15.52 Channels   Fwtm =  48.32 Channels


ROI # 11-3    RANGE :  581 to  645
              AREA : Gross = 1386     Net = 1018       +/- 68
              CENTROID : 626.30
              SHAPE : Fwhm =  17.54 Channels   Fwtm =  52.50 Channels
```

NP423RES.CHN
U

MCB # 1 ACQ 07-18-95 AT 10:21:01 RT : 170712.6 LT : 170711.8
No detector description was entered
NOPI 423 U count "RES" phase -channel 10- 7/20/95

ROI # 10-1 RANGE : 70 to 145
AREA : Gross = 3658 Net = 3468 +/- 75
CENTROID : 120.08
SHAPE : Fwhm = 21.22 Channels Fwtm = 48.57 Channels

ROI # 10-2 RANGE : 315 to 392
AREA : Gross = 3525 Net = 3310 +/- 77
CENTROID : 369.54
SHAPE : Fwhm = 21.10 Channels Fwtm = 49.31 Channels

ROI # 10-3 RANGE : 562 to 628
AREA : Gross = 1571 Net = 1470 +/- 50
CENTROID : 605.94
SHAPE : Fwhm = 16.90 Channels Fwtm = 50.23 Channels

NP423RTH.CHN

```
MCB # 1        ACQ 07-18-95  AT 10:21:01   RT : 170712.4   LT : 170711.6
               No detector description was entered
               channel 13 background 6/5/95

ROI # 13-1     RANGE :    20 to    57
               AREA : Gross = 144        Net = 87          +/- 20
               CENTROID : 39.20
               SHAPE : Fwhm =    1.38 Channels   Fwtm =  26.57 Channels

ROI # 13-2     RANGE :   259 to   355
               AREA : Gross = 3908       Net = 3738        +/- 79
               CENTROID : 328.89
               SHAPE : Fwhm =   29.97 Channels   Fwtm =  64.29 Channels

ROI # 13-3     RANGE :   592 to   676
               AREA : Gross = 1423       Net = 1025        +/- 79
               CENTROID : 650.17
               SHAPE : Fwhm =   18.99 Channels   Fwtm =  62.94 Channels

ROI # 13-4     RANGE :   705 to   783
               AREA : Gross = 846        Net = 491         +/- 69
               CENTROID : 750.19
               SHAPE : Fwhm =    1.50 Channels   Fwtm =  49.65 Channels
```

U and Th Isotope Activities

FILENAME= NP424ADU.CHN
NP424ADT.CHN

Sample # **NOPI-424-AD**
Analyst **JDP**

Sep. date **6/12/95**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.6502	0.0956	45.459	1/22/93	871	44.42727

Th-228/U-232= 0.643315

Counting time for Th=	0	(mins.)	Counting time for U=	12745	(mins.)
Days btwn. sep. and count.=	1	(days)	Days btwn. sep. and count.=	15	(days)
CF for Th-228=	#DIV/0!		CF for U-232=	1.0185658	

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
0	0	0	0

U-238 counts	U-234 counts	U-232 counts
134	218	147

Bkgd	Bkgd	Bkgd	bkgd
0	0	0	0

bkgd	bkgd	bkgd
3	6	8

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
0	0	#DIV/0!	0

U-238* counts	U-234* counts	U-232sp counts
131	212	136.46639

		±	
U-238(dpm/g)=	6.270558	±	0.748942
U-234(dpm/g)=	10.14777	±	1.083004
Th-232(dpm/g)=	#DIV/0!	±	#DIV/0!
Th-230(dpm/g)=	#DIV/0!	±	#DIV/0!
U-234/U-238=	1.618321	±	0.177646
Th-230/U-234=	#DIV/0!	±	#DIV/0!
Th-230/Th-232=	#DIV/0!	±	#DIV/0!
U234/Th-232=	#DIV/0!	±	#DIV/0!

Decay constant (m-1)	U-238	Th-232
	2.948E-16	9.413E-17

U(ppb)= 8405.392

Th(ppb)= #DIV/0!

	Spike 25A 10/9/92	Spike 25B	Spide 25C
Th-228 (dpm/g)=	2862.6531	285.95775	28.580729

U and Th Isotope Activities

FILENAME= NP424CRU.CHN
NP424CRT.CHN

Sample # **NOPI-424-CR**
Analyst **JDP**

Sep. date **6/15/95**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.6502	0.6533	45.459	1/22/93	874	44.42376

Th-228/U-232= 0.6445542

Counting time for Th= 0 (mins.)
Days btwn. sep. and count.= 1 (days)
CF for Th-228= #DIV/0!

Counting time for U= 12745 (mins.)
Days btwn. sep. and count.= 13 (days)
CF for U-232= 1.0166714

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
0	0	0	0

Bkgd	Bkgd	Bkgd	bkgd
0	0	0	0

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
0	0	#DIV/0!	0

U-238 counts	U-234 counts	U-232 counts
416	483	641

bkgd	bkgd	bkgd
4	5	28

U-238* counts	U-234* counts	U-232sp counts
412	478	602.94803

U-238(dpm/g)=	30.49989	±	1.92026
U-234(dpm/g)=	35.3858	±	2.13211
Th-232(dpm/g)=	#DIV/0!	±	#DIV/0!
Th-230(dpm/g)=	#DIV/0!	±	#DIV/0!
U-234/U-238=	1.160194	±	0.077605
Th-230/U-234=	#DIV/0!	±	#DIV/0!
Th-230/Th-232=	#DIV/0!	±	#DIV/0!
U234/Th-232=	#DIV/0!	±	#DIV/0!

Decay constant (m-1)	U-238	Th-232
	2.948E-16	9.413E-17

U(ppb)= 40883.69

Th(ppb)= #DIV/0!

	Spike 25A	Spike 25B	Spide 25C
	10/9/92		
Th-228 (dpm/g)=	2867.9406	286.48593	28.633519

U and Th Isotope Activities

FILENAME= NP424REU.CHN
NP424RET.CHN

Sample # **NOPI-424-RES**
Analyst **JDP**

Sep. date **6/15/95**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.6502	0.0603	45.459	1/22/93	874	44.42376

Th-228/U-232= 0.6445542

Counting time for Th=	2845.2	(mins.)	Counting time for U=	2845.2	(mins.)
Days btwn. sep. and count.=	9	(days)	Days btwn. sep. and count.=	9	(days)
CF for Th-228=	0.9901409		CF for U-232=	1.0095946	

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
550	1005	1033	454
Bkgd	Bkgd	Bkgd	bkgd
7	17	45	55

U-238 counts	U-234 counts	U-232 counts
1167	1122	600
bkgd	bkgd	bkgd
3	9	28

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
543	988	433.48024	399

U-238* counts	U-234* counts	U-232sp counts
1164	1113	566.56404

U-238(dpm/g)=	8.464272	±	0.425204
U-234(dpm/g)=	8.093415	±	0.409333
Th-232(dpm/g)=	3.326409	±	0.175584
Th-230(dpm/g)=	6.052471	±	0.268165
U-234/U-238=	0.956186	±	0.039979
Th-230/U-234=	0.747827	±	0.032479
Th-230/Th-232=	1.819521	±	0.096507
U234/Th-232=	2.433079	±	0.177867

Decay constant (m-1)	U-238	Th-232
	2.948E-16	9.413E-17

U(ppb)= 11345.96

Th(ppb)= 13613.74

	Spike 25A 10/9/92	Spike 25B	Spide 25C
Th-228 (dpm/g)=	2867.9406	286.48593	28.633519

NP424 ADU.CHN

```
MCB # 1        ACQ 08-01-95  AT 13:42:57   RT : 764744.5   LT : 764742.9
               No detector description was entered
               No sample description was entered

ROI #  8-1     RANGE :   82 to  145
               AREA : Gross = 150       Net = 134          +/- 17
               CENTROID : 128.24
               SHAPE : Fwhm =   2.01 Channels   Fwtm =  20.77 Channels


ROI #  8-2     RANGE :  328 to  400
               AREA : Gross = 236       Net = 218          +/- 20
               CENTROID : 367.52
               SHAPE : Fwhm =   2.02 Channels   Fwtm =  25.75 Channels


ROI #  8-3     RANGE :  571 to  628
               AREA : Gross = 292       Net = 147          +/- 37
               Could not properly fit the peak.
```

NP424CRU.CHN

```
MCB # 1       ACQ 08-01-95  AT 13:42:57   RT : 764744.6   LT : 764742.9
              No detector description was entered
              No sample description was entered

ROI #  7-1    RANGE :   88 to  152
              AREA : Gross = 417      Net = 416       +/- 21
              CENTROID : 125.85
              SHAPE : Fwhm =  12.46 Channels   Fwtm =  45.21 Channels


ROI #  7-2    RANGE :  327 to  395
              AREA : Gross = 655      Net = 483       +/- 48
              CENTROID : 376.54
              SHAPE : Fwhm =   7.55 Channels   Fwtm =  34.62 Channels


ROI #  7-3    RANGE :  560 to  634
              AREA : Gross = 916      Net = 641       +/- 62
              CENTROID : 619.22
              SHAPE : Fwhm =   6.55 Channels   Fwtm =  46.62 Channels
```

NP424 RES.CHN
U

```
MCB # 1       ACQ 07-18-95  AT 10:21:01   RT : 170712.7   LT : 170711.8
              No detector description was entered
              U count "CR" phase-channel 10 6/6/95

ROI #  9-1    RANGE :   74 to  155
              AREA : Gross = 1167      Net = 1167       +/- 34
              CENTROID : 137.07
              SHAPE : Fwhm =  13.71 Channels   Fwtm =  44.34 Channels

ROI #  9-2    RANGE :  332 to  405
              AREA : Gross = 1211      Net = 1122       +/- 46
              CENTROID : 387.13
              SHAPE : Fwhm =  15.29 Channels   Fwtm =  43.18 Channels

ROI #  9-3    RANGE :  572 to  641
              AREA : Gross = 653       Net = 600        +/- 34
              CENTROID : 619.87
              SHAPE : Fwhm =  13.88 Channels   Fwtm =  28.68 Channels
```

NP424RTH.CHN

ICB # 1 ACQ 07-18-95 AT 10:21:01 RT : 170712.5 LT : 170711.7
No detector description was entered
Th count NOPI-418 "AD" phase channel 2-6/7/95

ROI # 12-1 RANGE : 19 to 73
AREA : Gross = 734 Net = 550 +/- 45
CENTROID : 50.27
SHAPE : Fwhm = 15.24 Channels Fwtm = 43.49 Channels

ROI # 12-2 RANGE : 293 to 366
AREA : Gross = 1312 Net = 1005 +/- 67
CENTROID : 344.26
SHAPE : Fwhm = 13.58 Channels Fwtm = 58.23 Channels

ROI # 12-3 RANGE : 607 to 689
AREA : Gross = 1590 Net = 1033 +/- 90
CENTROID : 664.82
SHAPE : Fwhm = 21.11 Channels Fwtm = 37.56 Channels

ROI # 12-4 RANGE : 718 to 801
AREA : Gross = 1084 Net = 454 +/- 93
CENTROID : 761.80
SHAPE : Fwhm = 8.81 Channels Fwtm = 30.79 Channels

U and Th Isotope Activities

FILENAME= NP425AMU.CHN
NP425AMT.CHN

Sample # **NOPI-425-AM**
Analyst **JDP**

Sep. date 8/6/95

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.3609	1.1051	454.83	1/22/93	926	443.8634

Th-228/U-232= 0.6655249

Counting time for Th= 9912.9 (mins.)
Days btwn. sep. and count.= 12 (days)
CF for Th-228= 0.9847999

Counting time for U= 5703.7 (mins.)
Days btwn. sep. and count.= 12 (days)
CF for U-232= 1.0134015

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
0	3436	47742	49198

U-238 counts	U-234 counts	U-232 counts
1434	1898	99231

Bkgd	Bkgd	Bkgd	bkgd
0	15	20	20

bkgd	bkgd	bkgd
4	9	25

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
0	3421	45811.912	49178

U-238* counts	U-234* counts	U-232sp counts
1430	1889	97894.069

		±	
U-238(dpm/g)=	19.8538	±	0.528062
U-234(dpm/g)=	26.22645	±	0.607723
Th-232(dpm/g)=	0	±	#DIV/0!
Th-230(dpm/g)=	67.54652	±	1.193075
U-234/U-238=	1.320979	±	0.04622
Th-230/U-234=	2.575511	±	0.073657
Th-230/Th-232=	#DIV/0!	±	#DIV/0!
U234/Th-232=	#DIV/0!	±	#DIV/0!

Decay constant (m-1)	U-238	Th-232
	2.948E-16	9.413E-17

U(ppb)= 26613.1

Th(ppb)= 0

	Spike 25A 10/9/92	Spike 25B	Spide 25C
Th-228 (dpm/g)=	2957.1982	295.40211	29.524668

U and Th Isotope Activities

FILENAME= NP425CRU.CHN
NP425CRT.CHN

Sample # **NOPI-372-CR**
Analyst **JDP**

Sep. date **9/15/95**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.3609	0.7628	4553.22	1/22/93	966	4438.753

Th-228/U-232= 0.6810185

Counting time for Th= 11696 (mins.)
Days btwn. sep. and count.= 20 (days)
CF for Th-228= 0.9764162

Counting time for U= 11694 (mins.)
Days btwn. sep. and count.= 20 (days)
CF for U-232= 1.0229416

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
0	3760	660990	462693

U-238 counts	U-234 counts	U-232 counts
385	364	164283

Bkgd	Bkgd	Bkgd	bkgd
0	10	25	60

bkgd	bkgd	bkgd
22	23	33

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
0	3750	651817.82	462633

U-238* counts	U-234* counts	U-232sp counts
363	341	160566.35

		±	
U-238(dpm/g)=	21.20981	±	1.082218
U-234(dpm/g)=	19.92437	±	1.045477
Th-232(dpm/g)=	0	±	#DIV/0!
Th-230(dpm/g)=	36.75773	±	0.601155
U-234/U-238=	0.939394	±	0.068676
Th-230/U-234=	1.844863	±	0.10127
Th-230/Th-232=	#DIV/0!	±	#DIV/0!
U234/Th-232=	#DIV/0!	±	#DIV/0!

Decay constant (m-1)	U-238	Th-232
	2.948E-16	9.413E-17

U(ppb)= 28430.77

Th(ppb)= 0

	Spike 25A 10/9/92	Spike 25B	Spide 25C
Th-228 (dpm/g)=	3022.8726	301.96249	30.180361

U and Th Isotope Activities

FILENAME= NP425REU.CHN
NP425RET.CHN

Sample # **NOPI-425-RES**
Analyst **JDP**

Sep. date **9/21/95**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.3609	0.2681	454.83	1/22/93	972	443.3255

Th-228/U-232= 0.6833012

Counting time for Th=	0	(mins.)
Days btwn. sep. and count.=	12	(days)
CF for Th-228=	#DIV/0!	

Counting time for U=	1666.67	(mins.)
Days btwn. sep. and count.=	24	(days)
CF for U-232=	1.0234322	

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
0	0	0	0

U-238 counts	U-234 counts	U-232 counts
430	428	5704

Bkgd	Bkgd	Bkgd	bkgd
0	0	0	0

bkgd	bkgd	bkgd
4	5	25

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
0	0	#DIV/0!	0

U-238* counts	U-234* counts	U-232sp counts
426	423	5548.9753

		±	
U-238(dpm/g)=	25.28305	±	1.264379
U-234(dpm/g)=	25.105	±	1.2582
Th-232(dpm/g)=	#DIV/0!	±	#DIV/0!
Th-230(dpm/g)=	#DIV/0!	±	#DIV/0!
U-234/U-238=	0.992958	±	0.067798
Th-230/U-234=	#DIV/0!	±	#DIV/0!
Th-230/Th-232=	#DIV/0!	±	#DIV/0!
U234/Th-232=	#DIV/0!	±	#DIV/0!

Decay constant (m-1)	U-238	Th-232
	2.948E-16	9.413E-17

U(ppb)= 33890.76

Th(ppb)= #DIV/0!

	Spike 25A	Spike 25B	Spide 25C
	10/9/92		
Th-228 (dpm/g)=	3032.5069	302.92488	30.276549

NP425ADT.CHN

MCB # 1 ACQ 08-28-95 AT 09:53:03 RT : 342233.2 LT : 342222.9
No detector description was entered
No sample description was entered

ROI # 8-1 RANGE : 284 to 356
AREA : Gross = 4012 Net = 2490 +/- 140
CENTROID : 337.31
SHAPE : Fwhm = 18.75 Channels Fwtm = 56.39 Channels

ROI # 8-2 RANGE : 577 to 687
AREA : Gross = 48573 Net = 42001 +/- 396
CENTROID : 658.43
SHAPE : Fwhm = 24.32 Channels Fwtm = 70.55 Channels

ROI # 8-3 RANGE : 700 to 801
AREA : Gross = 43027 Net = 38116 +/- 342
CENTROID : 768.98
SHAPE : Fwhm = 35.12 Channels Fwtm = 68.80 Channels

NP425AMU.CHN

```
MCB # 1      ACQ 08-28-95  AT 09:53:03   RT : 342233.1   LT : 342222.8
             No detector description was entered
             No sample description was entered

ROI #  9-1   RANGE :   65 to  154
             AREA : Gross = 1884      Net = 1434       +/- 88
             CENTROID : 128.91
             SHAPE : Fwhm =  33.66 Channels   Fwtm =  61.78 Channels


ROI #  9-2   RANGE :  317 to  403
             AREA : Gross = 3043      Net = 1898       +/- 132
             CENTROID : 376.50
             SHAPE : Fwhm =  33.79 Channels   Fwtm =  65.20 Channels


ROI #  9-3   RANGE :  486 to  642
             AREA : Gross = 105646    Net = 99231      +/- 511
             CENTROID : 606.29
             SHAPE : Fwhm =  48.21 Channels   Fwtm =  91.96 Channels
```

NP425AMT.CHN

```
MCB # 1       ACQ 08-18-95  AT 12:54:19   RT : 594782.5   LT : 594772.8
              No detector description was entered
              No sample description was entered

ROI # 15-1    RANGE :   264 to  357
              AREA : Gross = 5158      Net = 3436       +/- 169
              CENTROID : 333.79
              SHAPE : Fwhm =  43.85 Channels   Fwtm =  63.71 Channels

ROI # 15-2    RANGE :   593 to  682
              AREA : Gross = 59502     Net = 47742      +/- 461
              CENTROID : 652.17
              SHAPE : Fwhm =  25.98 Channels   Fwtm =  69.12 Channels

ROI # 15-3    RANGE :   699 to  797
              AREA : Gross = 54428     Net = 49198      +/- 361
              CENTROID : 765.17
              SHAPE : Fwhm =  27.95 Channels   Fwtm =  58.26 Channels
```

NP425RES CHN
U

```
MCB # 1       ACQ 10-23-95  AT 08:45:12   RT : 100001.0   LT : 100000.0
              No detector description was entered
              NOPI 425 U count RES phase-channel 7-10/25/95

ROI #  7-1    RANGE :   92 =    4.11MeV  to  148 =    4.24MeV
              AREA : Gross = 638      Net = 430        +/- 47
              CENTROID : 116.04  =   4.16MeV
              SHAPE : Fwhm =   0.00MeV   Fwtm =   0.11MeV

              ID : No close library match


ROI #  7-2    RANGE :  329 =    4.66MeV  to  400 =    4.83MeV
              AREA : Gross = 536      Net = 428        +/- 40
              CENTROID : 375.01  =   4.77MeV
              SHAPE : Fwhm =   0.03MeV   Fwtm =   0.12MeV

              ID : No close library match


ROI #  7-3    RANGE :  540 =    5.15MeV  to  640 =    5.38MeV
              AREA : Gross = 6259     Net = 5704       +/- 120
              CENTROID : 605.43  =   5.30MeV
              SHAPE : Fwhm =   0.11MeV   Fwtm =   0.17MeV

              ID : No close library match
```

NP425 CRUCHN

```
MCB # 1      ACQ 10-05-95  AT 10:30:30   RT : 701751.5   LT : 701646.8
             No detector description was entered
             NOPI-425 U crystalline

ROI # 14-1   RANGE :   92 =    4.10MeV  to  150 =    4.23MeV
             AREA : Gross = 620       Net = 385        +/- 50
             CENTROID : 134.18  =    4.20MeV
             SHAPE : Fwhm =   0.03MeV    Fwtm =   0.06MeV

             ID : No close library match


ROI # 14-2   RANGE :  303 =    4.59MeV  to  361 =    4.73MeV
             AREA : Gross = 934       Net = 364        +/- 73
             CENTROID : 345.79  =    4.69MeV
             SHAPE : Fwhm =   0.01MeV    Fwtm =   0.02MeV

             ID : No close library match


ROI # 14-3   RANGE :  558 =    5.19MeV  to  645 =    5.39MeV
             AREA : Gross = 167422    Net = 164283     +/- 455
             CENTROID : 621.45  =    5.34MeV
             SHAPE : Fwhm =   0.04MeV    Fwtm =   0.11MeV

             ID : No close library match
```

NP425CRT.CHN

ICB 1 ACQ 10-05-95 AT 10:30:29 RT : 701880.9 LT : 701776.2
No detector description was entered
NOPI-425 Th crystalline

ROI # 6-1 RANGE : 285 = 4.53MeV to 352 = 4.71MeV
AREA : Gross = 7031 Net = 3760 +/- 194
CENTROID : 334.89 = 4.66MeV
SHAPE : Fwhm = 0.05MeV Fwtm = 0.13MeV

ID : No close library match

ROI # 6-2 RANGE : 536 = 5.22MeV to 625 = 5.46MeV
AREA : Gross = 759735 Net = 660990 +/- 1429
CENTROID : 603.50 = 5.40MeV
SHAPE : Fwhm = 0.05MeV Fwtm = 0.17MeV

ID : No close library match

ROI # 6-3 RANGE : 642 = 5.51MeV to 718 = 5.72MeV
AREA : Gross = 516844 Net = 462693 +/- 1050
CENTROID : 697.14 = 5.66MeV
SHAPE : Fwhm = 0.06MeV Fwtm = 0.14MeV

ID : No close library match

U and Th Isotope Activities

FILENAME= NP426IEU.CHN
NP426IET.CHN

Sample # **NOPI-426-IE**
Analyst **JDP**

Sep. date 9/20/95

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.5955	0.5022	454.83	1/22/93	971	443.3372

Th-228/U-232= 0.6829223

Counting time for Th= 2580.8 (mins.)
Days btwn. sep. and count.= 10 (days)
CF for Th-228= 0.9892492

Counting time for U= 2580.8 (mins.)
Days btwn. sep. and count.= 11 (days)
CF for U-232= 1.0114163

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
0	394	12390	6102
Bkgd	Bkgd	Bkgd	bkgd
0	10	40	30

U-238 counts	U-234 counts	U-232 counts
7727	6839	9526
bkgd	bkgd	bkgd
6	8	10

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
0	384	12158.902	6072

U-238* counts	U-234* counts	U-232sp counts
7721	6831	9408.5884

U-238(dpm/g)=	306.8161	±	4.697316
U-234(dpm/g)=	271.4494	±	4.302247
Th-232(dpm/g)=	0	±	#DIV/0!
Th-230(dpm/g)=	8.063754	±	0.412655
U-234/U-238=	0.88473	±	0.014689
Th-230/U-234=	0.029706	±	0.001539
Th-230/Th-232=	#DIV/0!	±	#DIV/0!
U234/Th-232=	#DIV/0!	±	#DIV/0!

Decay constant (m-1)	U-238	Th-232
	2.948E-16	9.413E-17

U(ppb)= 411272.8

Th(ppb)= 0

	Spike 25A 10/9/92	Spike 25B	Spide 25C
Th-228 (dpm/g)=	3030.905	302.76487	30.260557

U and Th Isotope Activities

FILENAME= NP426ADU.CHN
NP426ADT.CHN

Sample # **NOPI-426-AD**
Analyst **JDP**

Sep. date 9/20/95

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.5955	0.5158	454.83	1/22/93	971	443.3372

Th-228/U-232= 0.6829223

Counting time for Th=	0	(mins.)
Days btwn. sep. and count.=	10	(days)
CF for Th-228=	#DIV/0!	

Counting time for U=	2580.8	(mins.)
Days btwn. sep. and count.=	11	(days)
CF for U-232=	1.0114163	

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
0	0	0	0

U-238 counts	U-234 counts	U-232 counts
1903	1694	27154

Bkgd	Bkgd	Bkgd	bkgd
0	0	0	0

bkgd	bkgd	bkgd
7	18	30

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
0	0	#DIV/0!	0

U-238* counts	U-234* counts	U-232sp counts
1896	1676	26817.839

		±	
U-238(dpm/g)=	27.14865	±	0.64378
U-234(dpm/g)=	23.99849	±	0.600991
Th-232(dpm/g)=	#DIV/0!	±	#DIV/0!
Th-230(dpm/g)=	#DIV/0!	±	#DIV/0!
U-234/U-238=	0.883966	±	0.029528
Th-230/U-234=	#DIV/0!	±	#DIV/0!
Th-230/Th-232=	#DIV/0!	±	#DIV/0!
U234/Th-232=	#DIV/0!	±	#DIV/0!

Decay constant (m-1)	U-238	Th-232
	2.948E-16	9.413E-17

U(ppb)= 36391.51

Th(ppb)= #DIV/0!

	Spike 25A 10/9/92	Spike 25B	Spide 25C
Th-228 (dpm/g)=	3030.905	302.76487	30.260557

NP426amu CHN

Probably more ^{234}U counts due to ^{230}Th interference

```
# 1       ACQ 10-03-95  AT 14:16:58   RT : 154857.4   LT : 154850.5
          No detector description was entered
          NOPI 426 U count AM phase-channel 14-10/5/95

# 14-1    RANGE :   90 =    4.09MeV  to  145 =    4.22MeV
          AREA : Gross = 552        Net = 485        +/- 32
          CENTROID : 126.54  =    4.18MeV
          SHAPE : Fwhm =   0.03MeV    Fwtm =   0.08MeV

          ID : No close library match


  14-2    RANGE :  356 =    4.72MeV  to  398 =    4.81MeV
          AREA : Gross = 177        Net = 69         +/- 27
          CENTROID : 376.38  =    4.76MeV
          SHAPE : Fwhm =   0.01MeV    Fwtm =   0.02MeV

          ID : No close library match


  14-3    RANGE :  551 =    5.17MeV  to  634 =    5.36MeV
          AREA : Gross = 6733       Net = 6567       +/- 93
          CENTROID : 612.56  =    5.31MeV
          SHAPE : Fwhm =   0.04MeV    Fwtm =   0.12MeV

          ID : No close library match
```

WP426amt.chn

MCB # 1 ACQ 10-05-95 AT 10:30:29 RT : 701481.8 LT : 701377.2
No detector description was entered
NOPI-426 Th amorphous

ROI # 10-1 RANGE : 239 = 4.48MeV to 359 = 4.76MeV
AREA : Gross = 7462 Net = 6227 +/- 173
CENTROID : 326.96 = 4.68MeV
SHAPE : Fwhm = 0.10MeV Fwtm = 0.18MeV

ID : No close library match

ROI # 10-2 RANGE : 589 = 5.30MeV to 683 = 5.52MeV
AREA : Gross = 53499 Net = 42178 +/- 458
CENTROID : 651.49 = 5.45MeV
SHAPE : Fwhm = 0.07MeV Fwtm = 0.17MeV

ID : No close library match

ROI # 10-3 RANGE : 700 = 5.56MeV to 792 = 5.78MeV
AREA : Gross = 41858 Net = 36850 +/- 331
CENTROID : 764.12 = 5.71MeV
SHAPE : Fwhm = 0.07MeV Fwtm = 0.15MeV

ID : No close library match

NP4261EU.CHN

```
MCB # 1       ACQ 10-03-95  AT 14:16:57   RT : 154857.6   LT : 154850.7
              No detector description was entered
              No sample description was entered

ROI #  8-1    RANGE :   50 =    4.01MeV  to  150 =    4.24MeV
              AREA : Gross = 8165      Net = 7727       +/- 121
              CENTROID : 119.23  =    4.17MeV
              SHAPE : Fwhm =   0.09MeV    Fwtm =   0.14MeV

              ID : No close library match


ROI #  8-2    RANGE :  303 =    4.59MeV  to  400 =    4.82MeV
              AREA : Gross = 7215      Net = 6839       +/- 112
              CENTROID : 368.44  =    4.75MeV
              SHAPE : Fwhm =   0.09MeV    Fwtm =   0.15MeV

              ID : No close library match


ROI #  8-3    RANGE :  540 =    5.15MeV  to  636 =    5.37MeV
              AREA : Gross = 10108     Net = 9526       +/- 135
              CENTROID : 606.02  =    5.30MeV
              SHAPE : Fwhm =   0.09MeV    Fwtm =   0.15MeV

              ID : No close library match
```

NP4261ET.CHN

```
MCB # 1       ACQ 10-03-95   AT 14:16:56    RT : 154857.7    LT : 154850.8
              No detector description was entered
              No sample description was entered

ROI #  4-1    RANGE :   312 =     4.54MeV  to   376 =     4.71MeV
              AREA : Gross = 524       Net = 394          +/- 41
              CENTROID : 366.31  =     4.68MeV
              SHAPE : Fwhm =   0.01MeV    Fwtm =   0.10MeV

              ID : No close library match


ROI #  4-2    RANGE :   567 =     5.23MeV  to   658 =     5.48MeV
              AREA : Gross = 14813     Net = 12390        +/- 217
              CENTROID : 635.89  =     5.42MeV
              SHAPE : Fwhm =   0.07MeV    Fwtm =   0.19MeV

              ID : No close library match


ROI #  4-3    RANGE :   675 =     5.52MeV  to   756 =     5.74MeV
              AREA : Gross = 7401      Net = 6102         +/- 150
              CENTROID : 731.09  =     5.68MeV
              SHAPE : Fwhm =   0.10MeV    Fwtm =   0.16MeV

              ID : No close library match
```

NP426ADU.CHN

```
MCB # 1      ACQ 10-03-95  AT 14:16:57   RT : 154857.5   LT : 154850.6
             No detector description was entered
             No sample description was entered

ROI # 11-1   RANGE :   87 =    4.08MeV  to  162 =    4.25MeV
             AREA : Gross = 1905      Net = 1903       +/- 44
             CENTROID : 137.45  =    4.20MeV
             SHAPE : Fwhm =   0.06MeV    Fwtm =   0.13MeV

             ID : No close library match


ROI # 11-2   RANGE :  326 =    4.63MeV  to  409 =    4.82MeV
             AREA : Gross = 2156      Net = 1694       +/- 88
             CENTROID : 388.30  =    4.77MeV
             SHAPE : Fwhm =   0.04MeV    Fwtm =   0.14MeV

             ID : No close library match


ROI # 11-3   RANGE :  548 =    5.14MeV  to  649 =    5.37MeV
             AREA : Gross = 28703     Net = 27154      +/- 228
             CENTROID : 622.32  =    5.31MeV
             SHAPE : Fwhm =   0.09MeV    Fwtm =   0.15MeV

             ID : No close library match
```

84 items | 437K in disk | 1,004K available

Name	Label	Last Modified	V
CONFIG.M2	—	Thu, Oct 19, 1995, 3:38 PM	—
MCB0110.STR	—	Mon, Jul 10, 1995, 12:04 PM	—
~~NP417ADU.CHN~~	—	Thu, Oct 5, 1995, 9:22 AM	—
~~NP417AMT.CHN~~	—	Thu, Oct 5, 1995, 9:24 AM	—
~~NP417AMU.CHN~~	—	Thu, Oct 5, 1995, 9:19 AM	—
~~NP417IET.CHN~~	—	Fri, Oct 13, 1995, 1:16 PM	—
~~NP417IEU.CHN~~	—	Fri, Oct 13, 1995, 1:15 PM	—
NP418ADT.CHN - recount	—	Wed, Jun 7, 1995, 10:14 AM	—
NP418ADU.CHN - bad resolution	—	Tue, Jun 6, 1995, 9:26 AM	—
~~NP418AMT.CHN~~	—	Fri, Jun 9, 1995, 10:25 AM	—
~~NP418AMU.CHN~~	—	Tue, Jun 6, 1995, 9:27 AM	—
~~NP418CRT.CHN~~	—	Mon, Jun 12, 1995, 9:19 AM	—
~~NP418CRU.CHN~~	—	Tue, Jun 6, 1995, 9:28 AM	—
NP418IET.CHN recount	—	Wed, Jun 7, 1995, 10:13 AM	—
NP418IEU.CHN no counts	—	Tue, Jun 6, 1995, 9:27 AM	—
NP419ADT.CHN - recount	—	Mon, Sep 25, 1995, 11:35 AM	—
~~NP419AMT.CHN~~	—	Fri, Aug 25, 1995, 10:14 AM	—
~~NP419AMU.CHN~~	—	Fri, Aug 25, 1995, 10:09 AM	—
~~NP419CRT.CHN~~	—	Fri, Oct 13, 1995, 1:22 PM	—
~~NP419CRU.CHN~~	—	Fri, Oct 13, 1995, 1:20 PM	—
NP419IET.CHN no counts	—	Fri, Aug 25, 1995, 10:11 AM	—
NP419IEU.CHN - no counts	—	Mon, Sep 25, 1995, 11:39 AM	—
NP419RES.CHN - no counts	—	Wed, Oct 25, 1995, 8:24 AM	—
~~NP419RTH.CHN~~	—	Wed, Oct 25, 1995, 8:27 AM	—
~~NP420ADU.CHN~~	—	Thu, Oct 5, 1995, 9:21 AM	—
~~NP420AMT.CHN~~	—	Thu, Oct 5, 1995, 9:23 AM	—
~~NP420AMU.CHN~~	—	Thu, Oct 5, 1995, 9:19 AM	—

84 items 437K in disk 1,004K available

Name	Label	Last Modified	V
~~NP420IET.CHN~~ - No counts	—	Thu, Oct 5, 1995, 9:27 AM	—
~~NP420IEU.CHN~~ - No counts	—	Fri, Oct 13, 1995, 1:16 PM	—
~~NP421ADT.CHN~~	—	Tue, Sep 5, 1995, 2:30 PM	—
~~NP421ADU.CHN~~	—	Tue, Sep 5, 1995, 1:04 PM	—
~~NP421AMT.CHN~~	—	Mon, Sep 18, 1995, 9:35 AM	—
~~NP421AMU.CHN~~	—	Tue, Sep 5, 1995, 1:08 PM	—
~~NP421CRT.CHN~~	—	Fri, Oct 13, 1995, 1:23 PM	—
~~NP421CRU.CHN~~	—	Fri, Oct 13, 1995, 1:20 PM	—
~~NP421IET.CHN~~ No counts	—	Tue, Sep 5, 1995, 2:27 PM	—
~~NP421IEU.CHN~~	—	Tue, Sep 5, 1995, 12:56 PM	—
~~NP421RES.CHN~~ - No count	—	Fri, Oct 27, 1995, 9:19 AM	—
~~NP421RTH.CHN~~ - bad res	—	Fri, Oct 27, 1995, 9:20 AM	—
~~NP422ADT.CHN~~	—	Tue, Sep 5, 1995, 2:31 PM	—
~~NP422ADU.CHN~~	—	Tue, Sep 5, 1995, 2:33 PM	—
~~NP422AMT.CHN~~	—	Mon, Sep 18, 1995, 9:36 AM	—
~~NP422AMU.CHN~~	—	Mon, Sep 25, 1995, 11:35 AM	—
~~NP422CRT.CHN~~	—	Fri, Oct 13, 1995, 1:23 PM	—
~~NP422CRU.CHN~~	—	Fri, Oct 13, 1995, 1:21 PM	—
~~NP422IET.CHN~~ bad res ~~few~~ counts	—	Tue, Sep 5, 1995, 2:28 PM	—
~~NP422IEU.CHN~~	—	Tue, Sep 5, 1995, 1:01 PM	—
~~NP422RES.CHN~~	—	Wed, Oct 25, 1995, 8:22 AM	—
~~NP423ADT.CHN~~ bad res few counts	—	Mon, Jul 17, 1995, 8:15 AM	—
~~NP423ADU.CHN~~	—	Thu, Jul 13, 1995, 12:26 PM	—
~~NP423AMT.CHN~~ bad res few counts	—	Mon, Jul 17, 1995, 8:23 AM	—
~~NP423AMU.CHN~~ bad res few counts inf.	—	Mon, Jul 10, 1995, 11:31 AM	—
~~NP423CRT.CHN~~ bad res few counts.	—	Tue, Jul 18, 1995, 9:36 AM	—
NP423CRU.CHN		Mon, Jul 10, 1995, 11:24 AM	

84 items 437K in disk 1,004K available

Name	Label	Last Modified	V
~~NP423CRU.CHN~~	—	Mon, Jul 10, 1995, 11:34 AM	—
~~NP423IET.CHN~~ bad res few conts	—	Mon, Jul 17, 1995, 8:24 AM	—
~~NP423IEU.CHN~~	—	Mon, Jul 10, 1995, 11:29 AM	—
~~NP423RES.CHN~~	—	Thu, Jul 20, 1995, 9:48 AM	—
~~NP423RTH.CHN~~	—	Thu, Jul 20, 1995, 9:51 AM	—
~~NP424ADT.CHN~~ few conts bad res	—	Thu, Aug 10, 1995, 10:15 AM	—
~~NP424ADU.CHN~~	—	Thu, Aug 10, 1995, 10:07 AM	—
~~NP424AMT.CHN~~ few conts bad res	—	Mon, Jul 17, 1995, 8:17 AM	—
~~NP424AMU.CHN~~ interference from th.	—	Thu, Aug 10, 1995, 10:11 AM	—
~~NP424CRT.CHN~~ few conts	—	Thu, Aug 10, 1995, 10:14 AM	—
~~NP424CRU.CHN~~	—	Thu, Aug 10, 1995, 10:05 AM	—
~~NP424IET.CHN~~ few conts	—	Tue, Jul 18, 1995, 9:33 AM	—
~~NP424IEU.CHN~~ interference from Th.	—	Thu, Aug 10, 1995, 10:09 AM	—
~~NP424RES.CHN~~	—	Thu, Jul 20, 1995, 9:47 AM	—
~~NP424RTH.CHN~~	—	Thu, Jul 20, 1995, 9:50 AM	—
~~NP425ADT.CHN~~	—	Fri, Sep 1, 1995, 8:58 AM	—
~~NP425ADU.CHN~~ no conts	—	Mon, Sep 25, 1995, 11:36 AM	—
~~NP425AMT.CHN~~	—	Fri, Aug 25, 1995, 10:13 AM	—
~~NP425AMU.CHN~~	—	Fri, Sep 1, 1995, 8:59 AM	—
~~NP425CRT.CHN~~	—	Fri, Oct 13, 1995, 1:24 PM	—
~~NP425CRU.CHN~~	—	Fri, Oct 13, 1995, 1:22 PM	—
~~NP425IET.CHN~~ no conts	—	Fri, Sep 1, 1995, 9:01 AM	—
~~NP425IEU.CHN~~ no conts	—	Mon, Sep 25, 1995, 11:37 AM	—
~~NP425RES.CHN~~	—	Wed, Oct 25, 1995, 8:20 AM	—
~~NP426ADU.CHN~~	—	Thu, Oct 5, 1995, 9:20 AM	—
~~NP426AMT.CHN~~	—	Fri, Oct 13, 1995, 1:17 PM	—
~~NP426AMU.CHN~~	—	Thu, Oct 5, 1995, 9:18 AM	—

Untitled-MS

84 items 437K in disk 1,004K available

Name	Label	Last Modified	V
~~NP426IET.CHN~~	—	Thu, Oct 5, 1995, 9:26 AM	—
~~NP426IEU.CHN~~	—	Thu, Oct 5, 1995, 9:22 AM	—
REIN	—	Tue, Aug 1, 1995, 11:16 AM	—
REIN2	—	Wed, Aug 16, 1995, 12:17 PM	—

U and Th Isotope Activities

FILENAME= NP423U3.CHN
NP423TH3.CHN

Sample # **NOPI-423**
Analyst **JDP**

Sep. date **1/4/95**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.3347	0.2981	454.83	1/22/93	712	446.374

Th-228/U-232= 0.5727428

Counting time for Th= 1122.25 (mins.)
Days btwn. sep. and count.= 13 (days)
CF for Th-228= 0.986805

Counting time for U= 500.03 (mins.)
Days btwn. sep. and count.= 12 (days)
CF for U-232= 1.0116811

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
94	6736	3127	1584

Bkgd	Bkgd	Bkgd	bkgd
5	12	25	25

U-238 counts	U-234 counts	U-232 counts
3101	3465	3554

bkgd	bkgd	bkgd
1	8	12

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
89	6724	2970.7462	1559

U-238* counts	U-234* counts	U-232sp counts
3100	3457	3501.1033

U-238(dpm/g)=	352.0156	±	8.650205
U-234(dpm/g)=	392.5542	±	9.371885
Th-232(dpm/g)=	6.821648	±	0.714096
Th-230(dpm/g)=	515.3793	±	11.15235
U-234/U-238=	1.115161	±	0.027567
Th-230/U-234=	1.312887	±	0.027447
Th-230/Th-232=	75.55056	±	7.846628
U234/Th-232=	57.54537	±	6.178579

Decay constant (m-1)	U-238	Th-232
	2.948E-16	9.413E-17

U(ppb)= 471860.6

Th(ppb)= 27918.43

	Spike 25A 10/9/92	Spike 25B	Spide 25C
Th-228 (dpm/g)=	2559.3248	255.65752	25.5523

U and Th Isotope Activities

FILENAME= NP424U.CHN
NP424TH.CHN

Sample # **NOPI-424**
Analyst **JDP**

Sep. date **1/23/95**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.5122	0.9995	454.83	1/22/93	731	446.1506

Th-228/U-232= 0.5817043

Counting time for Th= 971.5 (mins.)
Days btwn. sep. and count.= 2 (days)
CF for Th-228= 0.997684

Counting time for U= 1155.647 (mins.)
Days btwn. sep. and count.= 2 (days)
CF for U-232= 1.0023159

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
137	1188	8042	1171
Bkgd	Bkgd	Bkgd	bkgd
15	44	25	47
Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
122	1144	7853.8999	1124

U-238 counts	U-234 counts	U-232 counts
1717	1810	26055
bkgd	bkgd	bkgd
6	14	10
U-238* counts	U-234* counts	U-232sp counts
1711	1796	25984.822

		±	
U-238(dpm/g)=	57.32643	±	1.428328
U-234(dpm/g)=	60.17433	±	1.462702
Th-232(dpm/g)=	7.86686	±	0.677812
Th-230(dpm/g)=	73.76793	±	2.292864
U-234/U-238=	1.049679	±	0.035362
Th-230/U-234=	1.225904	±	0.045775
Th-230/Th-232=	9.377049	±	0.846069
U234/Th-232=	7.649091	±	0.684775

Decay constant (m-1)	U-238	Th-232
	2.948E-16	9.413E-17

U(ppb)= 76843.42

Th(ppb)= 32196.09

	Spike 25A 10/9/92	Spike 25B	Spide 25C
Th-228 (dpm/g)=	2598.0684	259.52771	25.939115

U and Th Isotope Activities

FILENAME= NP425U3.CHN
NP425TH3.CHN

Sample # **NOPI-425**
Analyst **JDP**

Sep. date **1/4/95**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.2607	0.2978	454.83	1/22/93	712	446.374

Th-228/U-232= 0.5727428

Counting time for Th= 1123.3 (mins.)
Days btwn. sep. and count.= 13 (days)
CF for Th-228= 0.9868047

Counting time for U= 500.03 (mins.)
Days btwn. sep. and count.= 12 (days)
CF for U-232= 1.0116811

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
92	5051	3034	1531

U-238 counts	U-234 counts	U-232 counts
3147	3487	4781

Bkgd	Bkgd	Bkgd	bkgd
26	110	35	20

bkgd	bkgd	bkgd
12	14	18

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
66	4941	2891.9481	1511

U-238* counts	U-234* counts	U-232sp counts
3135	3473	4708.0053

		±	
U-238(dpm/g)=	339.5339	±	7.793944
U-234(dpm/g)=	376.1408	±	8.376552
Th-232(dpm/g)=	6.664931	±	0.705324
Th-230(dpm/g)=	498.961	±	11.46067
U-234/U-238=	1.107815	±	0.027238
Th-230/U-234=	1.326527	±	0.029207
Th-230/Th-232=	74.86364	±	7.875835
U234/Th-232=	56.43581	±	6.103189

Decay constant (m-1)	U-238	Th-232
	2.948E-16	9.413E-17

U(ppb)= 455129.5

Th(ppb)= 27277.05

	Spike 25A 10/9/92	Spike 25B	Spide 25C
Th-228 (dpm/g)=	2559.3248	255.65752	25.5523

U and Th Isotope Activities

FILENAME= NP417U3.CHN
NP417TH3.CHN

Sample # **NOPI-417**
Analyst **JDP**

Sep. date **1/4/95**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.3068	0.2972	454.83	1/22/93	712	446.374

Th-228/U-232= 0.5727428

Counting time for Th=	416.75	(mins.)
Days btwn. sep. and count.=	13	(days)
CF for Th-228=	0.9870448	

Counting time for U=	500.03	(mins.)
Days btwn. sep. and count.=	12	(days)
CF for U-232=	1.0116811	

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
39	38876	2320	2568
Bkgd	Bkgd	Bkgd	bkgd
3	35	12	10

U-238 counts	U-234 counts	U-232 counts
3817	4907	620
bkgd	bkgd	bkgd
2	2	6

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
36	38841	2164.9395	2558

U-238* counts	U-234* counts	U-232sp counts
3815	4905	606.91062

		±	
U-238(dpm/g)=	2718.08	±	117.6928
U-234(dpm/g)=	3494.674	±	148.9524
Th-232(dpm/g)=	4.118212	±	0.664961
Th-230(dpm/g)=	4443.208	±	94.95971
U-234/U-238=	1.285714	±	0.027748
Th-230/U-234=	1.271423	±	0.019262
Th-230/Th-232=	1078.917	±	172.8516
U234/Th-232=	848.59	±	141.7139

Decay constant (m-1)	U-238	Th-232
	2.948E-16	9.413E-17

U(ppb)= 3643460

Th(ppb)= 16854.29

	Spike 25A 10/9/92	Spike 25B	Spide 25C
Th-228 (dpm/g)=	2559.3248	255.65752	25.5523

U and Th Isotope Activities

FILENAME= NP418U3.CHN
NP418TH3.CHN

Sample # **NOPI-418**
Analyst **JDP**

Sep. date **1/4/95**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.4288	0.493	454.83	1/22/93	712	446.374

Th-228/U-232= 0.5727428

Counting time for Th= 416.75 (mins.)
Days btwn. sep. and count.= 13 (days)
CF for Th-228= 0.9870448

Counting time for U= 500.03 (mins.)
Days btwn. sep. and count.= 12 (days)
CF for U-232= 1.0116811

	Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
Counts	44	38200	2826	2429
Bkgd	1	10	40	20

	Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
	43	38190	2650.214	2409

	U-238 counts	U-234 counts	U-232 counts
Counts	3899	5007	774
bkgd	0	0	5

	U-238* counts	U-234* counts	U-232sp counts
	3899	5007	760.12095

	Value	±
U-238(dpm/g)=	2632.459	103.5887
U-234(dpm/g)=	3380.539	130.5654
Th-232(dpm/g)=	4.76912	0.724547
Th-230(dpm/g)=	4235.644	82.5717
U-234/U-238=	1.284175	0.027428
Th-230/U-234=	1.252949	0.018832
Th-230/Th-232=	888.1395	133.9692
U234/Th-232=	708.8392	111.1157

Decay constant (m-1)	U-238	Th-232
	2.948E-16	9.413E-17

U(ppb)= 3528689

Th(ppb)= 19518.21

	Spike 25A 10/9/92	Spike 25B	Spide 25C
Th-228 (dpm/g)=	2559.3248	255.65752	25.5523

U and Th Isotope Activities

FILENAME= NP419U3.CHN
NP419TH3.CHN

Sample # **NOPI-419**
Analyst **JDP**

Sep. date **1/4/95**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.2608	0.2984	454.83	1/22/93	712	446.374

Th-228/U-232= 0.5727428

Counting time for Th=	1339.82	(mins.)
Days btwn. sep. and count.=	13	(days)
CF for Th-228=	0.9867311	

Counting time for U=	500.03	(mins.)
Days btwn. sep. and count.=	12	(days)
CF for U-232=	1.0116811	

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
199	14824	3554	2873

U-238 counts	U-234 counts	U-232 counts
2731	4461	2414

Bkgd	Bkgd	Bkgd	bkgd
0	6	2	1

bkgd	bkgd	bkgd
3	5	12

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
199	14818	3246.502	2872

U-238* counts	U-234* counts	U-232sp counts
2728	4456	2374.266

		±	
U-238(dpm/g)=	586.8203	±	16.39337
U-234(dpm/g)=	958.5306	±	24.21908
Th-232(dpm/g)=	17.93029	±	1.306144
Th-230(dpm/g)=	1335.13	±	24.93627
U-234/U-238=	1.633431	±	0.039687
Th-230/U-234=	1.392893	±	0.023786
Th-230/Th-232=	74.46231	±	5.313805
U234/Th-232=	53.45875	±	4.121844

Decay constant (m-1)	U-238	Th-232
	2.948E-16	9.413E-17

U(ppb)= 786605.4

Th(ppb)= 73381.89

	Spike 25A 10/9/92	Spike 25B	Spide 25C
Th-228 (dpm/g)=	2559.3248	255.65752	25.5523

U and Th Isotope Activities

FILENAME= NP420U3.CHN
NP420TH3.CHN

Sample # **NOPI-420**
Analyst **JDP**

Sep. date **1/4/95**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.3412	0.2981	454.83	1/22/93	712	446.374

Th-228/U-232= 0.5727428

Counting time for Th=	416.75	(mins.)
Days btwn. sep. and count.=	13	(days)
CF for Th-228=	0.9870448	

Counting time for U=	500.03	(mins.)
Days btwn. sep. and count.=	12	(days)
CF for U-232=	1.0116811	

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
44	10224	1204	838

U-238 counts	U-234 counts	U-232 counts
3329	4276	1094

Bkgd	Bkgd	Bkgd	bkgd
0	0	10	6

bkgd	bkgd	bkgd
13	15	13

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
44	10224	1120.9967	832

U-238* counts	U-234* counts	U-232sp counts
3316	4261	1068.5185

U-238(dpm/g)=	1210.276	±	42.17715
U-234(dpm/g)=	1555.182	±	52.69155
Th-232(dpm/g)=	8.767179	±	1.345636
Th-230(dpm/g)=	2037.174	±	62.0711
U-234/U-238=	1.284982	±	0.029701
Th-230/U-234=	1.309926	±	0.023856
Th-230/Th-232=	232.3636	±	35.10543
U234/Th-232=	177.3869	±	27.8818

Decay constant (m-1)	U-238	Th-232
	2.948E-16	9.413E-17

U(ppb)= 1622319

Th(ppb)= 35880.76

	Spike 25A 10/9/92	Spike 25B	Spide 25C
Th-228 (dpm/g)=	2559.3248	255.65752	25.5523

U and Th Isotope Activities

FILENAME= NP421U3.CHN
NP421TH3.CHN

Sample # **NOPI-421**
Analyst **JDP**

Sep. date **1/4/95**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.3235	0.2966	454.83	1/22/93	712	446.374

Th-228/U-232= 0.5727428

Counting time for Th= 416.75 (mins.)
Days btwn. sep. and count.= 13 (days)
CF for Th-228= 0.9870448

Counting time for U= 500.03 (mins.)
Days btwn. sep. and count.= 12 (days)
CF for U-232= 1.0116811

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
72	15947	1465	814

U-238 counts	U-234 counts	U-232 counts
5721	6776	1273

Bkgd	Bkgd	Bkgd	bkgd
0	1	10	12

bkgd	bkgd	bkgd
8	15	8

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
72	15946	1359.0333	802

U-238* counts	U-234* counts	U-232sp counts
5713	6761	1250.394

U-238(dpm/g)=	1869.877	±	57.94631
U-234(dpm/g)=	2212.89	±	67.59738
Th-232(dpm/g)=	12.41818	±	1.499028
Th-230(dpm/g)=	2750.281	±	75.08326
U-234/U-238=	1.183441	±	0.021248
Th-230/U-234=	1.242846	±	0.018023
Th-230/Th-232=	221.4722	±	26.15961
U234/Th-232=	178.1977	±	22.18873

Decay constant (m-1)	U-238	Th-232
	2.948E-16	9.413E-17

U(ppb)= 2506484

Th(ppb)= 50822.91

	Spike 25A 10/9/92	Spike 25B	Spide 25C
Th-228 (dpm/g)=	2559.3248	255.65752	25.5523