

ALPHA SPECTROMETRY
OF
NOPAL I SAMPLES

U and Th Isotope Activities

FILENAME= NP417PUA.CHN
NP417PTA.CHN

Sample # **NOPI-417-PWDA**
Analyst **JDP**

Sep. date **12/28/95**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.7272	1.0152	454.83	1/22/93	1070	442.18188

Th-228/U-232= **0.7188892**

Counting time for Th= **833.33** (mins.)
Days btwn. sep. and count.= **6** (days)
CF for Th-228= **0.9937803**

Counting time for U= **1181.79** (mins.)
Days btwn. sep. and count.= **6** (days)
CF for U-232= **1.0061695**

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
103	108380	13312	2115

U-238 counts	U-234 counts	U-232 counts
10933	11280	2104

Bkgd	Bkgd	Bkgd	bkgd
1	2	8	3

bkgd	bkgd	bkgd
2	4	21

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
102	108378	13172.629	2112

U-238* counts	U-234* counts	U-232sp counts
10931	11276	2070.2277

U-238(dpm/g)= **3259.421** ± **77.59554**
U-234(dpm/g)= **3362.2936** ± **79.84563**

Th-232(dpm/g)= **3.4362787** ± **0.339894**
Th-230(dpm/g)= **3651.1472** ± **33.53236**

U-234/U-238= **1.0315616** ± **0.013844**
Th-230/U-234= **1.0859097** ± **0.010743**
Th-230/Th-232= **1062.5294** ± **104.7439**
U234/Th-232= **978.4694** ± **99.53393**

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

U(ppb)= **4369102.6**

Th(ppb)= **14063.393**

Spike 25A Spike 25B Spike 25C
10/9/92
Th-228 (dpm/g)= **3182.2167** **317.87979** **31.771253**

NP417 PUA.CHN

1 ACQ 01-03-96 AT 13:41:32 RT : 70924.6 LT : 70907.3
No detector description was entered
NOPI-417-PWD U 1/4/96

OI # 7-1 RANGE : 51 = 4.01MeV to 161 = 4.27MeV
AREA : Gross = 20368 Net = 10933 +/- 420
CENTROID : 122.83 = 4.18MeV
SHAPE : Fwhm = 0.11MeV Fwtm = 0.19MeV

²³⁸U

ID : No close library match

OI # 7-2 RANGE : 306 = 4.61MeV to 407 = 4.84MeV
AREA : Gross = 18114 Net = 11280 +/- 347
CENTROID : 371.62 = 4.76MeV
SHAPE : Fwhm = 0.12MeV Fwtm = 0.19MeV

²³⁴U

ID : No close library match

OI # 7-3 RANGE : 541 = 5.15MeV to 642 = 5.39MeV
AREA : Gross = 3414 Net = 2104 +/- 152
CENTROID : 609.01 = 5.31MeV
SHAPE : Fwhm = 0.10MeV Fwtm = 0.17MeV

²³²U

ID : No close library match

ICB # 1 ACQ 01-03-96 AT 13:41:31 RT : 50014.7 LT : 50000.0
 No detector description was entered
 NOPI-417-PWD Th 1/4/95

ROI # 2-1 RANGE : 60 = 3.95MeV to 93 = 4.04MeV 232 Th
 AREA : Gross = 212 Net = 103 +/- 25
 CENTROID : 79.34 = 4.00MeV
 SHAPE : Fwhm = 0.02MeV Fwtm = 0.05MeV

ID : No close library match

ROI # 2-2 RANGE : 262 = 4.47MeV to 365 = 4.73MeV 230 Th
 AREA : Gross = 109420 Net = 108380 +/- 354
 CENTROID : 346.35 = 4.68MeV
 SHAPE : Fwhm = 0.04MeV Fwtm = 0.13MeV

ID : No close library match

ROI # 2-3 RANGE : 581 = 5.28MeV to 663 = 5.49MeV 228 Th
 AREA : Gross = 13907 Net = 13312 +/- 145
 CENTROID : 643.57 = 5.44MeV
 SHAPE : Fwhm = 0.04MeV Fwtm = 0.14MeV

ID : No close library match

ROI # 2-4 RANGE : 702 = 5.59MeV to 770 = 5.76MeV 224 Ra
 AREA : Gross = 3391 Net = 2115 +/- 125
 CENTROID : 746.53 = 5.70MeV
 SHAPE : Fwhm = 0.06MeV Fwtm = 0.11MeV

ID : No close library match

U and Th Isotope Activities

FILENAME= NP418PA.CHN
NP418PTA.CHNSample # NOPI-418-PWDA
Analyst JDP

Sep. date 12/28/95

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.5744	1.0032	454.83	1/22/93	1070	442.18188

Th-228/U-232= 0.7188892

Counting time for Th= 833.33 (mins.)
Days btwn. sep. and count.= 6 (days)
CF for Th-228= 0.9937803

Counting time for U= 1182.39 (mins.)
Days btwn. sep. and count.= 6 (days)
CF for U-232= 1.0061697

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
117	183352	11321	1796

U-238 counts	U-234 counts	U-232 counts
18111	21746	2281

Bkgd	Bkgd	Bkgd	bkgd
1	12	9	7

bkgd	bkgd	bkgd
2	2	6

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
116	183340	11171.387	1789

U-238* counts	U-234* counts	U-232sp counts
18109	21744	2261.05

U-238(dpm/g)= 6185.2654 ± 137.4214
U-234(dpm/g)= 7426.827 ± 163.456

Th-232(dpm/g)= 5.764835 ± 0.535706
Th-230(dpm/g)= 9111.4211 ± 88.23761

U-234/U-238= 1.2007289 ± 0.012079
Th-230/U-234= 1.2268255 ± 0.008799
Th-230/Th-232= 1580.5172 ± 146.1655
U234/Th-232= 1288.2983 ± 123.029

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

U(ppb)= 8291061.3

Th(ppb)= 23593.296

Spike 25A Spike 25B Spide 25C
10/9/92
Th-228 (dpm/g)= 3182.2167 317.87979 31.771253

CB # 1 ACQ 01-03-96 AT 13:41:32 RT : 70961.0 LT : 70943.7
No detector description was entered
NOPI-418-PWD U 1/4/96

ROI # 8-1 RANGE : 30 = 3.96MeV to 159 = 4.26MeV
AREA : Gross = 46603 Net = 18111 +/- 779
CENTROID : 112.50 = 4.15MeV
SHAPE : Fwhm = 0.14MeV Fwtm = 0.23MeV

ID : No close library match

ROI # 8-2 RANGE : 279 = 4.54MeV to 407 = 4.84MeV
AREA : Gross = 42086 Net = 21746 +/- 662
CENTROID : 361.19 = 4.73MeV
SHAPE : Fwhm = 0.16MeV Fwtm = 0.23MeV

ID : No close library match

ROI # 8-3 RANGE : 529 = 5.12MeV to 643 = 5.39MeV
AREA : Gross = 4140 Net = 2281 +/- 190
CENTROID : 606.69 = 5.30MeV
SHAPE : Fwhm = 0.12MeV Fwtm = 0.23MeV

ID : No close library match

CB # 1 ACQ 01-03-96 AT 13:41:31 RT : 50014.7 LT : 50000.0
No detector description was entered
NOPI-418-PWD Th 1/4/96

OI # 4-1 RANGE : 88 = 3.93MeV to 131 = 4.04MeV
AREA : Gross = 204 Net = 117 +/- 26
CENTROID : 119.49 = 4.01MeV
SHAPE : Fwhm = 0.00MeV Fwtm = 0.01MeV

ID : No close library match

OI # 4-2 RANGE : 271 = 4.42MeV to 390 = 4.75MeV
AREA : Gross = 184432 Net = 183352 +/- 452
CENTROID : 367.00 = 4.69MeV
SHAPE : Fwhm = 0.04MeV Fwtm = 0.13MeV

ID : No close library match

OI # 4-3 RANGE : 587 = 5.28MeV to 665 = 5.50MeV
AREA : Gross = 11741 Net = 11321 +/- 128
CENTROID : 645.01 = 5.44MeV
SHAPE : Fwhm = 0.04MeV Fwtm = 0.14MeV

ID : No close library match

OI # 4-4 RANGE : 703 = 5.60MeV to 765 = 5.77MeV
AREA : Gross = 3937 Net = 1796 +/- 149
CENTROID : 743.60 = 5.71MeV
SHAPE : Fwhm = 0.05MeV Fwtm = 0.09MeV

ID : No close library match

U and Th Isotope Activities

FILENAME= NP420PUA.CHN
NP420PTA.CHNSample # NOPI-420-PWDA
Analyst JDP

Sep. date 12/28/95

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.7867	1.0064	454.83	1/22/93	1070	442.18188

Th-228/U-232= 0.7188892

Counting time for Th= 833.33 (mins.)
Days btwn. sep. and count.= 6 (days)
CF for Th-228= 0.9937803

Counting time for U= 1182.98 (mins.)
Days btwn. sep. and count.= 6 (days)
CF for U-232= 1.0061699

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
176	34647	10605	1919

U-238 counts	U-234 counts	U-232 counts
4818	5322	2832

Bkgd	Bkgd	Bkgd	bkgd
1	3	2	1

bkgd	bkgd	bkgd
2	3	12

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
175	34644	10392.07	1918

U-238* counts	U-234* counts	U-232sp counts
4816	5319	2802.7076

U-238(dpm/g)= 972.01084 ± 23.01557
U-234(dpm/g)= 1073.5311 ± 24.96985

Th-232(dpm/g)= 6.8479466 ± 0.520449
Th-230(dpm/g)= 1355.6586 ± 15.04462

U-234/U-238= 1.1044435 ± 0.021963
Th-230/U-234= 1.2628033 ± 0.018592
Th-230/Th-232= 197.96571 ± 14.96008
U234/Th-232= 156.76686 ± 12.45988

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

U(ppb)= 1302935.4

Th(ppb)= 28026.063

Spike 25A Spike 25B Spide 25C
10/9/92
Th-228 (dpm/g)= 3182.2167 317.87979 31.771253

1 ACQ 01-03-96 AT 13:41:32 RT : 70996.2 LT : 70978.8
No detector description was entered
NOPI-420-PWD U 1/4/96

OI # 9-1 RANGE : 74 = 4.05MeV to 161 = 4.25MeV
AREA : Gross = 5068 Net = 4818 +/- 91
CENTROID : 137.09 = 4.20MeV
SHAPE : Fwhm = 0.07MeV Fwtm = 0.13MeV

ID : No close library match

OI # 9-2 RANGE : 330 = 4.65MeV to 414 = 4.84MeV
AREA : Gross = 5619 Net = 5322 +/- 96
CENTROID : 388.60 = 4.78MeV
SHAPE : Fwhm = 0.07MeV Fwtm = 0.14MeV

ID : No close library match

OI # 9-3 RANGE : 574 = 5.21MeV to 649 = 5.39MeV
AREA : Gross = 3113 Net = 2832 +/- 78
CENTROID : 625.74 = 5.33MeV
SHAPE : Fwhm = 0.04MeV Fwtm = 0.12MeV

ID : No close library match

NP 420 PTA.CHN

1 ACQ 01-03-96 AT 13:41:31 RT : 50014.7 LT : 50000.0
No detector description was entered
NOPI-420-PWD Th 1/4/96

ROI # 5-1 RANGE : 67 = 3.92MeV to 117 = 4.05MeV
AREA : Gross = 209 Net = 176 +/- 21
CENTROID : 101.27 = 4.01MeV
SHAPE : Fwhm = 0.02MeV Fwtm = 0.06MeV

ID : No close library match

ROI # 5-2 RANGE : 289 = 4.48MeV to 384 = 4.72MeV
AREA : Gross = 35143 Net = 34647 +/- 205
CENTROID : 365.64 = 4.68MeV
SHAPE : Fwhm = 0.04MeV Fwtm = 0.13MeV

ID : No close library match

ROI # 5-3 RANGE : 602 = 5.28MeV to 681 = 5.48MeV
AREA : Gross = 11045 Net = 10605 +/- 127
CENTROID : 662.20 = 5.43MeV
SHAPE : Fwhm = 0.05MeV Fwtm = 0.14MeV

ID : No close library match

ROI # 5-4 RANGE : 725 = 5.59MeV to 783 = 5.73MeV
AREA : Gross = 2450 Net = 1919 +/- 81
CENTROID : 765.78 = 5.69MeV
SHAPE : Fwhm = 0.05MeV Fwtm = 0.10MeV

ID : No close library match

U and Th Isotope Activities

FILENAME= NP421PUA.CHN
NP421PTA.CHNSample # NOPI-421-PWDA
Analyst JDP

Sep. date 12/14/95

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.4513	1.0078	454.83	1/22/93	1056	442.34508

Th-228/U-232= 0.7139879

Counting time for Th= 833.33 (mins.)
Days btwn. sep. and count.= 6 (days)
CF for Th-228= 0.9937803

Counting time for U= 1183.38 (mins.)
Days btwn. sep. and count.= 6 (days)
CF for U-232= 1.00617

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
78	32136	10704	1831

U-238 counts	U-234 counts	U-232 counts
4548	4956	2423

Bkgd	Bkgd	Bkgd	bkgd
2	7	2	1

bkgd	bkgd	bkgd
2	3	12

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
76	32129	10595.383	1830

U-238* counts	U-234* counts	U-232sp counts
4546	4953	2396.2153

U-238(dpm/g)= 1874.0183 ± 47.13401
U-234(dpm/g)= 2041.7977 ± 50.61382

Th-232(dpm/g)= 5.058922 ± 0.574893
Th-230(dpm/g)= 2138.6593 ± 23.86697

U-234/U-238= 1.0895293 ± 0.022373
Th-230/U-234= 1.0474393 ± 0.015985
Th-230/Th-232= 422.75 ± 47.92507
U234/Th-232= 403.60332 ± 46.94381

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

U(ppb)= 2512034.5

Th(ppb)= 20704.26

Spike 25A Spike 25B Spide 25C
10/9/92
Th-228 (dpm/g)= 3161.687 315.82902 31.566284

CB # 1 ACQ 01-03-96 AT 13:41:32 RT : 71020.4 LT : 71003.0
No detector description was entered
NOPI-421-PWD U 1/4/96

OI # 10-1 RANGE : 62 = 4.06MeV to 145 = 4.25MeV
AREA : Gross = 5120 Net = 4548 +/- 109
CENTROID : 118.07 = 4.19MeV
SHAPE : Fwhm = 0.08MeV Fwtm = 0.13MeV

ID : No close library match

OI # 10-2 RANGE : 313 = 4.65MeV to 394 = 4.84MeV
AREA : Gross = 5721 Net = 4956 +/- 121
CENTROID : 367.76 = 4.78MeV
SHAPE : Fwhm = 0.08MeV Fwtm = 0.14MeV

ID : No close library match

OI # 10-3 RANGE : 565 = 5.24MeV to 630 = 5.40MeV
AREA : Gross = 3012 Net = 2434 +/- 91
CENTROID : 606.78 = 5.34MeV
SHAPE : Fwhm = 0.06MeV Fwtm = 0.13MeV

ID : No close library match

NP421 PTA.CHW

CB # 1 ACQ 01-03-96 AT 13:41:32 RT : 50014.7 LT : 50000.0
No detector description was entered
NOPI-421-PWD Th 1/4/96

OI # 6-1 RANGE : 72 = 3.94MeV to 108 = 4.04MeV
AREA : Gross = 115 Net = 78 +/- 16
CENTROID : 100.75 = 4.02MeV
SHAPE : Fwhm = 0.00MeV Fwtm = 0.04MeV

ID : No close library match

OI # 6-2 RANGE : 271 = 4.49MeV to 356 = 4.72MeV
AREA : Gross = 32467 Net = 32136 +/- 191
CENTROID : 338.12 = 4.67MeV
SHAPE : Fwhm = 0.04MeV Fwtm = 0.12MeV

ID : No close library match

OI # 6-3 RANGE : 547 = 5.25MeV to 623 = 5.46MeV
AREA : Gross = 10986 Net = 10704 +/- 118
CENTROID : 605.95 = 5.41MeV
SHAPE : Fwhm = 0.04MeV Fwtm = 0.13MeV

ID : No close library match

OI # 6-4 RANGE : 658 = 5.55MeV to 715 = 5.71MeV
AREA : Gross = 2400 Net = 1831 +/- 82
CENTROID : 699.38 = 5.67MeV
SHAPE : Fwhm = 0.05MeV Fwtm = 0.09MeV

ID : No close library match

U and Th Isotope Activities

FILENAME= NP423PUA.CHN
NP423PTA.CHN

Sample # **NOPI-423-PWDA**
Analyst **JDP**

Sep. date **12/28/95**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.779	1.0067	454.83	1/22/93	1070	442.18188

Th-228/U-232= **0.7188892**

Counting time for Th= **833.33** (mins.)
Days btwn. sep. and count.= **6** (days)
CF for Th-228= **0.9937803**

Counting time for U= **1183.87** (mins.)
Days btwn. sep. and count.= **6** (days)
CF for U-232= **1.0061702**

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
168	15117	10449	2103

U-238 counts	U-234 counts	U-232 counts
1609	1863	1960

Bkgd	Bkgd	Bkgd	bkgd
0	1	5	22

bkgd	bkgd	bkgd
5	6	10

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
168	15116	10230.382	2081

U-238* counts	U-234* counts	U-232sp counts
1604	1857	1938.0419

U-238(dpm/g)= **472.93859** ± **15.91007**
U-234(dpm/g)= **547.53551** ± **17.71658**

Th-232(dpm/g)= **6.7459474** ± **0.524628**
Th-230(dpm/g)= **606.97465** ± **7.722035**

U-234/U-238= **1.1577307** ± **0.039402**
Th-230/U-234= **1.1085576** ± **0.02722**
Th-230/Th-232= **89.97619** ± **6.980281**
U234/Th-232= **81.165102** ± **6.836712**

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

U(ppb)= **633952.24**

Th(ppb)= **27608.619**

Spike 25A Spike 25B Spide 25C
10/9/92
Th-228 (dpm/g)= 3182.2167 317.87979 31.771253

NP423PuA.CAW

ICL # 1 ACQ 01-03-96 AT 13:41:32 RT : 71049.6 LT : 71032.3
No detector description was entered
NOPI-423-PWD U 1/4/96

OI # 11-1 RANGE : 94 = 4.10MeV to 167 = 4.26MeV
AREA : Gross = 1757 Net = 1609 +/- 57
CENTROID : 144.48 = 4.21MeV
SHAPE : Fwhm = 0.03MeV Fwtm = 0.09MeV

ID : No close library match

OI # 11-2 RANGE : 342 = 4.67MeV to 414 = 4.83MeV
AREA : Gross = 2215 Net = 1863 +/- 76
CENTROID : 395.38 = 4.79MeV
SHAPE : Fwhm = 0.04MeV Fwtm = 0.14MeV

ID : No close library match

OI # 11-3 RANGE : 582 = 5.22MeV to 654 = 5.38MeV
AREA : Gross = 2325 Net = 1960 +/- 78
CENTROID : 632.38 = 5.33MeV
SHAPE : Fwhm = 0.04MeV Fwtm = 0.11MeV

ID : No close library match

ICB # 2 ACQ 01-03-96 AT 13:42:25 RT : 50004.9 LT : 50000.0
No detector description was entered
NOPI-423-PWD Th 1/4/96

ROI # 1-1 RANGE : 159 = 3.95MeV to 215 = 4.02MeV
AREA : Gross = 224 Net = 168 +/- 25
CENTROID : 196.33 = 4.00MeV
SHAPE : Fwhm = 0.00MeV Fwtm = 0.01MeV

ID : No close library match

ROI # 1-2 RANGE : 583 = 4.53MeV to 723 = 4.72MeV
AREA : Gross = 15611 Net = 15117 +/- 162
CENTROID : 692.37 = 4.68MeV
SHAPE : Fwhm = 0.04MeV Fwtm = 0.12MeV

ID : No close library match

ROI # 1-3 RANGE : 1137 = 5.29MeV to 1278 = 5.48MeV
AREA : Gross = 10994 Net = 10449 +/- 151
CENTROID : 1245.76 = 5.44MeV
SHAPE : Fwhm = 0.04MeV Fwtm = 0.08MeV

ID : No close library match

ROI # 1-4 RANGE : 1378 = 5.62MeV to 1471 = 5.74MeV
AREA : Gross = 2479 Net = 2103 +/- 87
CENTROID : 1438.57 = 5.70MeV
SHAPE : Fwhm = 0.05MeV Fwtm = 0.09MeV

ID : No close library match

U and Th Isotope Activities

FILENAME= NP425PA.CHN
NP425PTA.CHN

Sample # **NOPI-425-PWDA**
Analyst **JDP**

Sep. date **12/14/95**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.665	1.0076	454.83	1/22/93	1056	442.34508

Th-228/U-232= **0.7139879**

Counting time for Th= **833.33** (mins.)
Days btwn. sep. and count.= **6** (days)
CF for Th-228= **0.9937803**

Counting time for U= **1184.22** (mins.)
Days btwn. sep. and count.= **6** (days)
CF for U-232= **1.0061703**

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
121	10120	10604	2865

U-238 counts	U-234 counts	U-232 counts
4250	4990	7242

Bkgd	Bkgd	Bkgd	bkgd
1	6	10	10

bkgd	bkgd	bkgd
3	6	8

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
120	10114	10388.042	2855

U-238* counts	U-234* counts	U-232sp counts
4247	4984	7189.6377

U-238(dpm/g)= **395.91592** ± **7.650275**
U-234(dpm/g)= **464.6209** ± **8.548068**

Th-232(dpm/g)= **5.5279752** ± **0.505402**
Th-230(dpm/g)= **465.91618** ± **6.474697**

U-234/U-238= **1.1735343** ± **0.024496**
Th-230/U-234= **1.0027878** ± **0.017346**
Th-230/Th-232= **84.283333** ± **7.707791**
U234/Th-232= **84.04902** ± **7.838332**

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

U(ppb)= **530706.93**

Th(ppb)= **22623.918**

Spike 25A Spike 25B Spide 25C
10/9/92
Th-228 (dpm/g)= 3161.687 315.82902 31.566284

NP42SPUA.cdw

ICB # 1 ACQ 01-03-96 AT 13:41:32 RT : 71070.9 LT : 71053.5
No detector description was entered
NOPI-425-PWD U 1/4/96

ROI # 12-1 RANGE : 65 = 4.03MeV to 164 = 4.26MeV
AREA : Gross = 4550 Net = 4250 +/- 95
CENTROID : 135.47 = 4.19MeV
SHAPE : Fwhm = 0.09MeV Fwtm = 0.17MeV

ID : No close library match

ROI # 12-2 RANGE : 311 = 4.60MeV to 412 = 4.83MeV
AREA : Gross = 5517 Net = 4990 +/- 116
CENTROID : 382.11 = 4.76MeV
SHAPE : Fwhm = 0.10MeV Fwtm = 0.16MeV

ID : No close library match

ROI # 12-3 RANGE : 565 = 5.19MeV to 651 = 5.38MeV
AREA : Gross = 9243 Net = 7242 +/- 185
CENTROID : 623.44 = 5.32MeV
SHAPE : Fwhm = 0.09MeV Fwtm = 0.14MeV

ID : No close library match

NP425PTA.CHW

ICB # 2 ACQ 01-03-96 AT 13:42:25 RT : 50004.9 LT : 50000.0
No detector description was entered
NOPI-425-PWD Th 1/4/96

ROI # 2-1 RANGE : 164 = 3.95MeV to 222 = 4.03MeV
AREA : Gross = 151 Net = 121 +/- 20
CENTROID : 208.27 = 4.01MeV
SHAPE : Fwhm = 0.01MeV Fwtm = 0.03MeV

ID : No close library match

ROI # 2-2 RANGE : 616 = 4.55MeV to 739 = 4.71MeV
AREA : Gross = 10430 Net = 10120 +/- 127
CENTROID : 712.77 = 4.68MeV
SHAPE : Fwhm = 0.03MeV Fwtm = 0.11MeV

ID : No close library match

ROI # 2-3 RANGE : 1169 = 5.28MeV to 1303 = 5.46MeV
AREA : Gross = 11117 Net = 10604 +/- 147
CENTROID : 1273.99 = 5.42MeV
SHAPE : Fwhm = 0.03MeV Fwtm = 0.06MeV

ID : No close library match

ROI # 2-4 RANGE : 1404 = 5.60MeV to 1501 = 5.73MeV
AREA : Gross = 3242 Net = 2865 +/- 93
CENTROID : 1467.55 = 5.68MeV
SHAPE : Fwhm = 0.04MeV Fwtm = 0.08MeV

ID : No close library match

U and Th Isotope Activities

FILENAME= NP417PU.CHN
NP417PTH.CHNSample # NOPI-417-PWD
Analyst JDP

Sep. date 12/14/95

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.7272	1.0152	454.83	1/22/93	1056	442.34508

Th-228/U-232= 0.7139879

Counting time for Th= 833.33 (mins.)
 Days btwn. sep. and count.= 6 (days)
 CF for Th-228= 0.9937803

Counting time for U= 1053.01 (mins.)
 Days btwn. sep. and count.= 6 (days)
 CF for U-232= 1.0061266

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
174	138380	16934	2953

U-238 counts	U-234 counts	U-232 counts
2213	2305	309

Bkgd	Bkgd	Bkgd	bkgd
1	2	8	3

bkgd	bkgd	bkgd
2	4	21

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
173	138378	16701.605	2950

U-238* counts	U-234* counts	U-232sp counts
2211	2301	286.24628

U-238(dpm/g)= 4769.8841 ± 289.6746
 U-234(dpm/g)= 4964.045 ± 300.7279

Th-232(dpm/g)= 4.5670698 ± 0.348003
 Th-230(dpm/g)= 3653.0751 ± 29.74044

U-234/U-238= 1.0407056 ± 0.030972
 Th-230/U-234= 0.7359069 ± 0.015455
 Th-230/Th-232= 799.87283 ± 60.67631
 U234/Th-232= 1086.9212 ± 105.8075

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

U(ppb)= 6393808.4

Th(ppb)= 18691.295

Spike 25A Spike 25B Spide 25C
 10/9/92
 Th-228 (dpm/g)= 3161.687 315.82902 31.566284

NP417PU.CHW

ICB # 1 ACQ 12-20-95 AT 15:21:30 RT : 63196.0 LT : 63180.4
No detector description was entered
NOPI-417-PWD U 12/21/95

ROI # 7-1 RANGE : 75 = 4.07MeV to 160 = 4.27MeV
AREA : Gross = 2214 Net = 2213 +/- 47
CENTROID : 133.79 = 4.21MeV
SHAPE : Fwhm = 0.04MeV Fwtm = 0.10MeV

ID : No close library match

ROI # 7-2 RANGE : 329 = 4.66MeV to 407 = 4.84MeV
AREA : Gross = 2448 Net = 2305 +/- 64
CENTROID : 383.88 = 4.79MeV
SHAPE : Fwhm = 0.04MeV Fwtm = 0.14MeV

ID : No close library match

ROI # 7-3 RANGE : 583 = 5.25MeV to 641 = 5.39MeV
AREA : Gross = 426 Net = 309 +/- 37
CENTROID : 618.22 = 5.33MeV
SHAPE : Fwhm = 0.01MeV Fwtm = 0.09MeV

ID : No close library match

NP417PTH.CHW

1 ACQ 12-20-95 AT 15:21:30 RT : 50015.2 LT : 50000.0
No detector description was entered
NOPI-417-PWD Th 12/21/95

OI # 2-1 RANGE : 54 = 3.94MeV to 96 = 4.04MeV
AREA : Gross = 302 Net = 174 +/- 31
CENTROID : 76.55 = 3.99MeV
SHAPE : Fwhm = 0.01MeV Fwtm = 0.05MeV

ID : No close library match

OI # 2-2 RANGE : 250 = 4.44MeV to 365 = 4.73MeV
AREA : Gross = 139888 Net = 138380 +/- 407
CENTROID : 345.57 = 4.68MeV
SHAPE : Fwhm = 0.05MeV Fwtm = 0.14MeV

ID : No close library match

OI # 2-3 RANGE : 574 = 5.26MeV to 664 = 5.49MeV
AREA : Gross = 17541 Net = 16934 +/- 160
CENTROID : 642.45 = 5.44MeV
SHAPE : Fwhm = 0.04MeV Fwtm = 0.14MeV

ID : No close library match

OI # 2-4 RANGE : 711 = 5.61MeV to 769 = 5.76MeV
AREA : Gross = 4546 Net = 2953 +/- 130
CENTROID : 745.87 = 5.70MeV
SHAPE : Fwhm = 0.05MeV Fwtm = 0.10MeV

ID : No close library match

U and Th Isotope Activities

FILENAME= NP418PU.CHN
NP418PTH.CHN

Sample # **NOPI-418-PWD**
Analyst **JDP**

Sep. date **12/14/95**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.5744	1.0032	454.83	1/22/93	1056	442.34508

Th-228/U-232= **0.7139879**

Counting time for Th= **833.33** (mins.)
Days btwn. sep. and count.= **6** (days)
CF for Th-228= **0.9937803**

Counting time for U= **1053.9** (mins.)
Days btwn. sep. and count.= **6** (days)
CF for U-232= **1.0061269**

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
119	288451	17728	2558

U-238 counts	U-234 counts	U-232 counts
2724	3200	312

Bkgd	Bkgd	Bkgd	bkgd
1	12	9	7

bkgd	bkgd	bkgd
2	2	6

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
118	288439	17575.848	2551

U-238* counts	U-234* counts	U-232sp counts
2722	3198	304.13658

U-238(dpm/g)= **6914.3881** ± **413.2604**
U-234(dpm/g)= **8123.5169** ± **481.8025**

Th-232(dpm/g)= **3.7033166** ± **0.34062**
Th-230(dpm/g)= **9052.3809** ± **70.04621**

U-234/U-238= **1.1748714** ± **0.030628**
Th-230/U-234= **1.1143426** ± **0.019808**
Th-230/Th-232= **2444.3983** ± **224.1238**
U234/Th-232= **2193.5788** ± **240.0681**

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

U(ppb)= **9268416.4**

Th(ppb)= **15156.278**

Spike 25A 10/9/92
Th-228 (dpm/g)= **3161.687** Spike 25B **315.82902** Spide 25C **31.566284**

NP418PU.CHN

1 ACQ 12-20-95 AT 15:21:30 RT : 63252.0 LT : 63236.5
No detector description was entered
NOPI-418-FWD U 12/21/95

OI # 8-1 RANGE : 70 = 4.05MeV to 154 = 4.25MeV
AREA : Gross = 2852 Net = 2724 +/- 66
CENTROID : 131.65 = 4.20MeV
SHAPE : Fwhm = 0.07MeV Fwtm = 0.13MeV

ID : No close library match

OI # 8-2 RANGE : 328 = 4.65MeV to 405 = 4.83MeV
AREA : Gross = 3915 Net = 3200 +/- 109
CENTROID : 381.87 = 4.78MeV
SHAPE : Fwhm = 0.06MeV Fwtm = 0.15MeV

ID : No close library match

OI # 8-3 RANGE : 571 = 5.22MeV to 645 = 5.39MeV
AREA : Gross = 352 Net = 314 +/- 27
CENTROID : 626.84 = 5.35MeV
SHAPE : Fwhm = 0.01MeV Fwtm = 0.12MeV

ID : No close library match

NP418 PTh.c.HW

ICB # 1 ACQ 12-20-95 AT 15:21:30 RT : 50015.2 LT : 50000.0
No detector description was entered
NOPI-418-PWD Th 12/21/95

ROI # 4-1 RANGE : 93 = 3.94MeV to 130 = 4.04MeV
AREA : Gross = 271 Net = 119 +/- 30
CENTROID : 119.44 = 4.01MeV
SHAPE : Fwhm = 0.01MeV Fwtm = 0.06MeV

ID : No close library match

ROI # 4-2 RANGE : 251 = 4.37MeV to 387 = 4.74MeV
AREA : Gross = 289684 Net = 288451 +/- 562
CENTROID : 365.17 = 4.68MeV
SHAPE : Fwhm = 0.05MeV Fwtm = 0.14MeV

ID : No close library match

ROI # 4-3 RANGE : 585 = 5.28MeV to 661 = 5.49MeV
AREA : Gross = 18652 Net = 17728 +/- 169
CENTROID : 643.00 = 5.44MeV
SHAPE : Fwhm = 0.04MeV Fwtm = 0.14MeV

ID : No close library match

ROI # 4-4 RANGE : 700 = 5.59MeV to 762 = 5.76MeV
AREA : Gross = 6244 Net = 2558 +/- 194
CENTROID : 741.02 = 5.70MeV
SHAPE : Fwhm = 0.05MeV Fwtm = 0.11MeV

ID : No close library match

U and Th Isotope Activities

FILENAME= NP420PU.CHN
NP420PTH.CHN

Sample # **NOPI-420-PWD**
Analyst **JDP**

Sep. date **12/14/95**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.7867	1.0064	454.83	1/22/93	1056	442.34508

Th-228/U-232= **0.7139879**

Counting time for Th= **833.33** (mins.)
Days btwn. sep. and count.= **6** (days)
CF for Th-228= **0.9937803**

Counting time for U= **1054.5** (mins.)
Days btwn. sep. and count.= **6** (days)
CF for U-232= **1.0061271**

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
259	56363	17323	2556

U-238 counts	U-234 counts	U-232 counts
2172	2436	1183

Bkgd	Bkgd	Bkgd	bkgd
1	3	2	1

bkgd	bkgd	bkgd
2	3	12

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
258	56360	17035.144	2555

U-238* counts	U-234* counts	U-232sp counts
2170	2433	1163.8688

U-238(dpm/g)= **1055.0629** ± **38.12434**
U-234(dpm/g)= **1182.9346** ± **41.92027**

Th-232(dpm/g)= **6.1190981** ± **0.383054**
Th-230(dpm/g)= **1336.7146** ± **11.61242**

U-234/U-238= **1.1211982** ± **0.033088**
Th-230/U-234= **1.1299987** ± **0.023384**
Th-230/Th-232= **218.44961** ± **13.60495**
U234/Th-232= **193.31846** ± **13.90623**

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

U(ppb)= **1414262.9**

Th(ppb)= **25043.161**

Spike 25A Spike 25B Spide 25C
10/9/92
Th-228 (dpm/g)= 3161.687 315.82902 31.566284

NP420PU.ctms

ICB # 1 ACQ 12-20-95 AT 15:21:30 RT : 63285.6 LT : 63270.1
No detector description was entered
NOPI-420-PWD U 12/21/95

OI # 9-1 RANGE : 82 = 4.07MeV to 160 = 4.25MeV
AREA : Gross = 2449 Net = 2172 +/- 74
CENTROID : 139.72 = 4.20MeV
SHAPE : Fwhm = 0.06MeV Fwtm = 0.12MeV

ID : No close library match

OI # 9-2 RANGE : 335 = 4.66MeV to 410 = 4.83MeV
AREA : Gross = 3475 Net = 2436 +/- 121
CENTROID : 390.11 = 4.79MeV
SHAPE : Fwhm = 0.03MeV Fwtm = 0.14MeV

ID : No close library match

OI # 9-3 RANGE : 576 = 5.22MeV to 649 = 5.39MeV
AREA : Gross = 1468 Net = 1183 +/- 66
CENTROID : 625.95 = 5.34MeV
SHAPE : Fwhm = 0.05MeV Fwtm = 0.13MeV

ID : No close library match

CB # 1 ACQ 12-20-95 AT 15:21:30 RT : 50015.2 LT : 50000.0
No detector description was entered
NOPI-420-PWD Th 12/21/95

OI # 5-1 RANGE : 68 = 3.93MeV to 115 = 4.05MeV
AREA : Gross = 345 Net = 259 +/- 29
CENTROID : 101.92 = 4.01MeV
SHAPE : Fwhm = 0.00MeV Fwtm = 0.08MeV

ID : No close library match

OI # 5-2 RANGE : 258 = 4.41MeV to 384 = 4.72MeV
AREA : Gross = 56787 Net = 56363 +/- 255
CENTROID : 364.19 = 4.67MeV
SHAPE : Fwhm = 0.05MeV Fwtm = 0.13MeV

ID : No close library match

OI # 5-3 RANGE : 590 = 5.25MeV to 682 = 5.48MeV
AREA : Gross = 17756 Net = 17323 +/- 154
CENTROID : 660.83 = 5.42MeV
SHAPE : Fwhm = 0.04MeV Fwtm = 0.14MeV

ID : No close library match

OI # 5-4 RANGE : 722 = 5.58MeV to 784 = 5.74MeV
AREA : Gross = 3459 Net = 2556 +/- 106
CENTROID : 763.01 = 5.68MeV
SHAPE : Fwhm = 0.06MeV Fwtm = 0.11MeV

ID : No close library match

U and Th Isotope Activities

FILENAME= NP421PU.CHN
NP421PTH.CHNSample # **NOPI-421-PWD**
Analyst **JDP**Sep. date **12/14/95**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.4513	1.0078	454.83	1/22/93	1056	442.34508

Th-228/U-232= **0.7139879**

Counting time for Th= **833.33** (mins.)
Days btwn. sep. and count.= **6** (days)
CF for Th-228= **0.9937803**

Counting time for U= **1055.1** (mins.)
Days btwn. sep. and count.= **6** (days)
CF for U-232= **1.0061273**

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
110	41647	12877	2344

U-238 counts	U-234 counts	U-232 counts
3801	3897	1468

Bkgd	Bkgd	Bkgd	bkgd
2	7	2	1

bkgd	bkgd	bkgd
2	3	12

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
108	41640	12722.624	2343

U-238* counts	U-234* counts	U-232sp counts
3799	3894	1447.133

U-238(dpm/g)= **2593.1705** ± **79.68622**
U-234(dpm/g)= **2658.0168** ± **81.39812**

Th-232(dpm/g)= **5.9869842** ± **0.57327**
Th-230(dpm/g)= **2308.315** ± **23.275**

U-234/U-238= **1.0250066** ± **0.023367**
Th-230/U-234= **0.8684351** ± **0.014548**
Th-230/Th-232= **385.55556** ± **36.8098**
U234/Th-232= **443.9659** ± **44.6321**

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

U(ppb)= **3476024.8**Th(ppb)= **24502.469**

Spike 25A Spike 25B Spide 25C
10/9/92
Th-228 (dpm/g)= 3161.687 315.82902 31.566284

NP421PU.C#W

1 ACQ 12-20-95 AT 15:21:30 RT : 63321.5 LT : 63306.0
No detector description was entered
NOPI-421-PWD U 12/21/95

ROI # 10-1 RANGE : 56 = 4.04MeV to 145 = 4.25MeV
AREA : Gross = 5032 Net = 3801 +/- 145
CENTROID : 117.13 = 4.19MeV
SHAPE : Fwhm = 0.09MeV Fwtm = 0.15MeV

ID : No close library match

ROI # 10-2 RANGE : 304 = 4.63MeV to 400 = 4.85MeV
AREA : Gross = 5562 Net = 3897 +/- 171
CENTROID : 367.17 = 4.78MeV
SHAPE : Fwhm = 0.09MeV Fwtm = 0.15MeV

ID : No close library match

ROI # 10-3 RANGE : 571 = 5.26MeV to 628 = 5.39MeV
AREA : Gross = 2357 Net = 1468 +/- 96
CENTROID : 604.95 = 5.34MeV
SHAPE : Fwhm = 0.05MeV Fwtm = 0.11MeV

ID : No close library match

NP421PTH-CHW

ICB # 1 ACQ 12-20-95 AT 15:21:30 RT : 50015.2 LT : 50000.0
No detector description was entered
NOPI-421-PWD Th 12/21/95

OI # 6-1 RANGE : 70 = 3.94MeV to 106 = 4.03MeV
AREA : Gross = 147 Net = 110 +/- 17
CENTROID : 89.00 = 3.99MeV
SHAPE : Fwhm = 0.00MeV Fwtm = 0.08MeV

ID : No close library match

OI # 6-2 RANGE : 217 = 4.34MeV to 357 = 4.73MeV
AREA : Gross = 41788 Net = 41647 +/- 212
CENTROID : 335.23 = 4.67MeV
SHAPE : Fwhm = 0.09MeV Fwtm = 0.16MeV

ID : No close library match

OI # 6-3 RANGE : 539 = 5.23MeV to 621 = 5.45MeV
AREA : Gross = 13874 Net = 12877 +/- 160
CENTROID : 603.34 = 5.40MeV
SHAPE : Fwhm = 0.05MeV Fwtm = 0.15MeV

ID : No close library match

OI # 6-4 RANGE : 651 = 5.54MeV to 714 = 5.71MeV
AREA : Gross = 3186 Net = 2344 +/- 102
CENTROID : 696.36 = 5.66MeV
SHAPE : Fwhm = 0.07MeV Fwtm = 0.12MeV

ID : No close library match

U and Th Isotope Activities

FILENAME= NP423PU.CHN
NP423PTH.CHNSample # NOPI-423-PWD
Analyst JDP

Sep. date 12/14/95

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.779	1.0067	454.83	1/22/93	1056	442.34508

Th-228/U-232= 0.7139879

Counting time for Th= 833.33 (mins.)
Days btwn. sep. and count.= 6 (days)
CF for Th-228= 0.9937803

Counting time for U= 1055.6 (mins.)
Days btwn. sep. and count.= 6 (days)
CF for U-232= 1.0061275

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
185	14125	9761	1968

U-238 counts	U-234 counts	U-232 counts
3956	4321	4973

Bkgd	Bkgd	Bkgd	bkgd
0	1	5	22

bkgd	bkgd	bkgd
5	6	10

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
185	14124	9528.2759	1946

U-238* counts	U-234* counts	U-232sp counts
3951	4315	4932.7745

U-238(dpm/g)= 457.86724 ± 9.754469
U-234(dpm/g)= 500.0499 ± 10.39952

Th-232(dpm/g)= 7.9245032 ± 0.588116
Th-230(dpm/g)= 605.00369 ± 7.963213

U-234/U-238= 1.0921286 ± 0.024032
Th-230/U-234= 1.2098866 ± 0.021033
Th-230/Th-232= 76.345946 ± 5.649704
U234/Th-232= 63.101735 ± 4.863489

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

U(ppb)= 613749.8

Th(ppb)= 32432.003

Spike 25A Spike 25B Spide 25C
10/9/92
Th-228 (dpm/g)= 3161.687 315.82902 31.566284

NP423PU.c#w

1 ACQ 12-20-95 AT 15:21:31 RT : 63350.0 LT : 63334.4
No detector description was entered
NOPI-423-PWD U 12/21/95

ROI # 11-1 RANGE : 78 = 4.06MeV to 167 = 4.26MeV
AREA : Gross = 4091 Net = 3956 +/- 76
CENTROID : 138.93 = 4.20MeV
SHAPE : Fwhm = 0.08MeV Fwtm = 0.13MeV

ID : No close library match

ROI # 11-2 RANGE : 335 = 4.65MeV to 417 = 4.84MeV
AREA : Gross = 4721 Net = 4321 +/- 97
CENTROID : 389.71 = 4.78MeV
SHAPE : Fwhm = 0.07MeV Fwtm = 0.14MeV

ID : No close library match

ROI # 11-3 RANGE : 571 = 5.19MeV to 653 = 5.38MeV
AREA : Gross = 5414 Net = 4973 +/- 103
CENTROID : 627.20 = 5.32MeV
SHAPE : Fwhm = 0.08MeV Fwtm = 0.13MeV

ID : No close library match

NP423 PTh.c #w

CB # 2 ACQ 12-20-95 AT 15:22:40 RT : 50007.1 LT : 50000.0
No detector description was entered
NOPI-423-PWD Th 12/21/95

OI # 1-1 RANGE : 155 = 3.94MeV to 212 = 4.02MeV
AREA : Gross = 242 Net = 185 +/- 26
CENTROID : 191.62 = 3.99MeV
SHAPE : Fwhm = 0.00MeV Fwtm = 0.02MeV

ID : No close library match

OI # 1-2 RANGE : 561 = 4.50MeV to 717 = 4.71MeV
AREA : Gross = 15513 Net = 14125 +/- 221
CENTROID : 691.13 = 4.68MeV
SHAPE : Fwhm = 0.05MeV Fwtm = 0.13MeV

ID : No close library match

OI # 1-3 RANGE : 1122 = 5.27MeV to 1272 = 5.47MeV
AREA : Gross = 10768 Net = 9761 +/- 185
CENTROID : 1244.40 = 5.43MeV
SHAPE : Fwhm = 0.04MeV Fwtm = 0.14MeV

ID : No close library match

OI # 1-4 RANGE : 1356 = 5.59MeV to 1465 = 5.74MeV
AREA : Gross = 2408 Net = 1968 +/- 98
CENTROID : 1438.26 = 5.70MeV
SHAPE : Fwhm = 0.05MeV Fwtm = 0.11MeV

ID : No close library match

U and Th Isotope Activities

FILENAME= NP425PU.CHN
NP425PTH.CHN

Sample # **NOPI-425-PWD**
Analyst **JDP**

Sep. date **12/14/95**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.665	1.0076	454.83	1/22/93	1056	442.34508

Th-228/U-232= **0.7139879**

Counting time for Th= **833.33** (mins.)
Days btwn. sep. and count.= **6** (days)
CF for Th-228= **0.9937803**

Counting time for U= **1056.5** (mins.)
Days btwn. sep. and count.= **6** (days)
CF for U-232= **1.0061278**

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
206	19267	19343	2973

U-238 counts	U-234 counts	U-232 counts
282	346	511

Bkgd	Bkgd	Bkgd	bkgd
1	6	10	10

bkgd	bkgd	bkgd
3	6	8

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
205	19261	19090.977	2963

U-238* counts	U-234* counts	U-232sp counts
279	340	499.9365

U-238(dpm/g)= **374.03916** ± **27.74717**
U-234(dpm/g)= **455.81833** ± **31.73465**

Th-232(dpm/g)= **5.1385934** ± **0.359924**
Th-230(dpm/g)= **482.80219** ± **4.91417**

U-234/U-238= **1.218638** ± **0.097767**
Th-230/U-234= **1.0591987** ± **0.057452**
Th-230/Th-232= **93.956098** ± **6.581134**
U234/Th-232= **88.704883** ± **8.760337**

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

U(ppb)= **501382.14**

Th(ppb)= **21030.325**

Spike 25A Spike 25B Spide 25C
10/9/92
Th-228 (dpm/g)= 3161.687 315.82902 31.566284

NP425PU.CTW

ICB # 1 ACQ 12-20-95 AT 15:21:31 RT : 63406.9 LT : 63391.3
No detector description was entered
NOPI-425-PWD U 12/21/95

ROI # 12-1 RANGE : 103 = 4.11MeV to 163 = 4.25MeV
AREA : Gross = 313 Net = 282 +/- 24
CENTROID : 145.86 = 4.21MeV
SHAPE : Fwhm = 0.02MeV Fwtm = 0.07MeV

ID : No close library match

ROI # 12-2 RANGE : 337 = 4.66MeV to 409 = 4.82MeV
AREA : Gross = 441 Net = 346 +/- 38
CENTROID : 389.90 = 4.78MeV
SHAPE : Fwhm = 0.01MeV Fwtm = 0.08MeV

ID : No close library match

ROI # 12-3 RANGE : 581 = 5.22MeV to 649 = 5.38MeV
AREA : Gross = 590 Net = 511 +/- 37
CENTROID : 629.64 = 5.34MeV
SHAPE : Fwhm = 0.03MeV Fwtm = 0.11MeV

ID : No close library match

WP425PTH.CHW

ICB # 2 ACQ 12-20-95 AT 15:22:40 RT : 50007.2 LT : 50000.0
No detector description was entered
NOPI-425-PWD Th 12/21/95

ROI # 2-1 RANGE : 161 = 3.94MeV to 226 = 4.03MeV
AREA : Gross = 272 Net = 206 +/- 29
CENTROID : 200.33 = 4.00MeV
SHAPE : Fwhm = 0.00MeV Fwtm = 0.03MeV

ID : No close library match

ROI # 2-2 RANGE : 543 = 4.45MeV to 738 = 4.71MeV
AREA : Gross = 19561 Net = 19267 +/- 169
CENTROID : 707.43 = 4.67MeV
SHAPE : Fwhm = 0.04MeV Fwtm = 0.14MeV

ID : No close library match

ROI # 2-3 RANGE : 1135 = 5.24MeV to 1301 = 5.46MeV
AREA : Gross = 20064 Net = 19343 +/- 197
CENTROID : 1267.63 = 5.42MeV
SHAPE : Fwhm = 0.05MeV Fwtm = 0.15MeV

ID : No close library match

ROI # 2-4 RANGE : 1363 = 5.54MeV to 1494 = 5.72MeV
AREA : Gross = 3633 Net = 2973 +/- 130
CENTROID : 1465.44 = 5.68MeV
SHAPE : Fwhm = 0.06MeV Fwtm = 0.10MeV

ID : No close library match

U and Th Isotope Activities

FILENAME= NP4941AU.CHN
NP4941ATH.CHN

Sample # **NOPI-494-SEP1**
Analyst **JDP**

Sep. date **10/11/95**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.0705	0.9161	454.83	1/22/93	992	443.09189

Th-228/U-232= **0.6908113**

Counting time for Th=	1666.81	(mins.)	Counting time for U=	1666.81	(mins.)
Days btwn. sep. and count.=	2	(days)	Days btwn. sep. and count.=	2	(days)
CF for Th-228=	0.9974452		CF for U-232=	1.0024868	

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
0	35610	145	660
Bkgd	Bkgd	Bkgd	bkgd
0	16	25	25

U-238 counts	U-234 counts	U-232 counts
12629	13088	211
bkgd	bkgd	bkgd
22	29	23

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
0	35594	86.566164	635

U-238* counts	U-234* counts	U-232sp counts
12607	13059	187.53364

U-238(dpm/g)= **387061.64** ± **26868.1**
U-234(dpm/g)= **400939** ± **27823.38**

Th-232(dpm/g)= **0** ± **#DIV/0!**
Th-230(dpm/g)= **1635443.8** ± **136092.4**

U-234/U-238= **1.0358531** ± **0.012921**
Th-230/U-234= **4.0790339** ± **0.041696**
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)= **518838168**

Th(ppb)= **0**

Spike 25A Spike 25B Spide 25C
10/9/92
Th-228 (dpm/g)= 3064.2209 306.09288 30.593182

U and Th Isotope Activities

FILENAME= NP4941BU.CHN
NP4941BTH.CHNSample # **NOPI-494-SEP1**
Analyst **JDP**Sep. date **10/11/95**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.0705	0.9161	454.83	1/22/93	992	443.09189

Th-228/U-232= 0.6908113

Counting time for Th=	1666.81	(mins.)	Counting time for U=	1666.81	(mins.)
Days btwn. sep. and count.=	2	(days)	Days btwn. sep. and count.=	2	(days)
CF for Th-228=	0.9974452		CF for U-232=	1.0024868	

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
0	103032	935	1677

U-238 counts	U-234 counts	U-232 counts
14115	14494	187

Bkgd	Bkgd	Bkgd	bkgd
0	7	0	0

bkgd	bkgd	bkgd
3	3	12

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
0	103025	848.28624	1677

U-238* counts	U-234* counts	U-232sp counts
14112	14491	174.56589

U-238(dpm/g)=	465453.98	±	34262.09
U-234(dpm/g)=	477954.48	±	35176.24

Th-232(dpm/g)=	0	±	#DIV/0!
Th-230(dpm/g)=	483066.8	±	15869.49

U-234/U-238=	1.0268566	±	0.012143
Th-230/U-234=	1.0106963	±	0.008966
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)= 623919462

Th(ppb)= 0

Spike 25A	Spike 25B	Spide 25C
10/9/92		
Th-228 (dpm/g)=	3064.2209	306.09288 30.593182

U and Th Isotope Activities

FILENAME= NP4941CU.CHN
NP4941CT.CHN

Sample # **NOPI-494-SEP1C**
Analyst **JDP**

Sep. date **3/4/96**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.0705	3.7507	4553.22	1/22/93	1137	4418.792

Th-228/U-232= **0.7415408**

Counting time for Th= **333.33** (mins.)
Days btwn. sep. and count.= **3** (days)
CF for Th-228= **0.9969139**

Counting time for U= **416.67** (mins.)
Days btwn. sep. and count.= **3** (days)
CF for U-232= **1.0030317**

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
0	12580	423987	66064

U-238 counts	U-234 counts	U-232 counts
3491	3289	110896

Bkgd	Bkgd	Bkgd	bkgd
0	2	5	4

bkgd	bkgd	bkgd
1	1	11

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
0	12578	421782.48	66060

U-238* counts	U-234* counts	U-232sp counts
3490	3288	110549.85

U-238(dpm/g)= **7421.54** ± **127.5703**
U-234(dpm/g)= **6991.984** ± **123.7129**

Th-232(dpm/g)= **0** ± **#DIV/0!**
Th-230(dpm/g)= **5198.582** ± **47.03203**

U-234/U-238= **0.94212** ± **0.022894**
Th-230/U-234= **0.743506** ± **0.014561**
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)= **9948230**

Th(ppb)= **0**

Spike 25A Spike 25B Spike 25C
10/9/92
Th-228 (dpm/g)= **3276.7145** **327.31941** **32.714719**

U and Th Isotope Activities

FILENAME= NP4942AU.CHN
NP4942ATH.CHN

Sample # **NOPI-494-SEP2**
Analyst **JDP**

Sep. date **10/11/95**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.0489	0.9087	454.83	1/22/93	992	443.09189

Th-228/U-232= **0.6908113**

Counting time for Th= **1666.81** (mins.)
Days btwn. sep. and count.= **2** (days)
CF for Th-228= **0.9974452**

Counting time for U= **1666.81** (mins.)
Days btwn. sep. and count.= **2** (days)
CF for U-232= **1.0024868**

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
0	10748	177	1122
Bkgd	Bkgd	Bkgd	bkgd
0	13	50	35

U-238 counts	U-234 counts	U-232 counts
12759	12740	234
bkgd	bkgd	bkgd
10	4	35

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
0	10735	69.566733	1087

U-238* counts	U-234* counts	U-232sp counts
12749	12736	198.50636

U-238(dpm/g)= **528819.15** ± **34885.56**
U-234(dpm/g)= **528279.92** ± **34850.45**

Th-232(dpm/g)= **0** ± **#DIV/0!**
Th-230(dpm/g)= **877738.88** ± **66515.92**

U-234/U-238= **0.9989803** ± **0.012512**
Th-230/U-234= **1.6615034** ± **0.021761**
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)= **708857537**

Th(ppb)= **0**

Spike 25A Spike 25B Spide 25C
10/9/92
Th-228 (dpm/g)= 3064.2209 306.09288 30.593182

U and Th Isotope Activities

FILENAME= NP4942BU.CHN
NP4942BTH.CHNSample # NOPI-494-SEP2
Analyst JDP

Sep. date 10/11/95

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.0489	0.9087	454.83	1/22/93	992	443.09189

Th-228/U-232= 0.6908113

Counting time for Th=	1666.81	(mins.)	Counting time for U=	1666.81	(mins.)
Days btwn. sep. and count.=	2	(days)	Days btwn. sep. and count.=	2	(days)
CF for Th-228=	0.9974452		CF for U-232=	1.0024868	

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
0	22278	415	7077

U-238 counts	U-234 counts	U-232 counts
12017	12116	278

Bkgd	Bkgd	Bkgd	bkgd
0	13	50	35

bkgd	bkgd	bkgd
2	3	13

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
0	22265	-8.24707	7042

U-238* counts	U-234* counts	U-232sp counts
12015	12113	264.34263

U-238(dpm/g)= 374250.19 ± 22704.18
U-234(dpm/g)= 377302.75 ± 22887.25

Th-232(dpm/g)= 0 ± #DIV/0!
Th-230(dpm/g)= -15356347 ± -760802

U-234/U-238= 1.0081565 ± 0.012979
Th-230/U-234= -40.70033 ± -0.45943
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)= 501665018

Th(ppb)= 0

	Spike 25A	Spike 25B	Spide 25C
Th-228 (dpm/g)=	3064.2209	306.09288	30.593182

U and Th Isotope Activities

FILENAME= NP4942CU.CHN
NP4942CT.CHN

Sample # **NOPI-494-SEP2C**
Analyst **JDP**

Sep. date **2/28/96**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.0489	4.2977	4553.22	1/22/93	1132	4419.374

Th-228/U-232= **0.7398947**

Counting time for Th= **416.67** (mins.)
Days btwn. sep. and count.= **5** (days)
CF for Th-228= **0.9949094**

Counting time for U= **416.67** (mins.)
Days btwn. sep. and count.= **5** (days)
CF for U-232= **1.0049547**

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
0	76	755240	154278

U-238 counts	U-234 counts	U-232 counts
3408	3430	194257

Bkgd	Bkgd	Bkgd	bkgd
0	2	5	4

bkgd	bkgd	bkgd
1	1	11

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
0	74	750880.92	154274

U-238* counts	U-234* counts	U-232sp counts
3407	3429	193288.32

U-238(dpm/g)= **6846.278** ± **118.2991**
U-234(dpm/g)= **6890.486** ± **118.6871**

Th-232(dpm/g)= **0** ± **#DIV/0!**
Th-230(dpm/g)= **28.32165** ± **3.24888**

U-234/U-238= **1.006457** ± **0.024342**
Th-230/U-234= **0.00411** ± **0.000477**
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)= **9177118**

Th(ppb)= **0**

Spike 25A Spike 25B Spide 25C
10/9/92
Th-228 (dpm/g)= 3269.8716 326.63585 32.646399

U and Th Isotope Activities

FILENAME= NP4943AU.CHN
NP4943ATH.CHNSample # NOPI-494-SEP3
Analyst JDP

Sep. date 10/11/95

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.0353	0.9088	454.83	1/22/93	992	443.09189

Th-228/U-232= 0.6908113

Counting time for Th= 1666.81 (mins.)
Days btwn. sep. and count.= 2 (days)
CF for Th-228= 0.9974452

Counting time for U= 1666.81 (mins.)
Days btwn. sep. and count.= 2 (days)
CF for U-232= 1.0024868

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
0	12851	256	303

U-238 counts	U-234 counts	U-232 counts
9313	9545	284

Bkgd	Bkgd	Bkgd	bkgd
0	0	0	0

bkgd	bkgd	bkgd
4	9	20

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
0	12851	240.55558	303

U-238* counts	U-234* counts	U-232sp counts
9309	9536	263.34511

U-238(dpm/g)= 403241.46 ± 24290.08
U-234(dpm/g)= 413074.5 ± 24873.44

Th-232(dpm/g)= 0 ± #DIV/0!
Th-230(dpm/g)= 420986.65 ± 26572.45

U-234/U-238= 1.024385 ± 0.01492
Th-230/U-234= 1.0191543 ± 0.013771
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)= 540526467

Th(ppb)= 0

Spike 25A Spike 25B Spide 25C
10/9/92
Th-228 (dpm/g)= 3064.2209 306.09288 30.593182

U and Th Isotope Activities

FILENAME= NP4943BU.CHN
NP4943BTH.CHNSample # **NOPI-494-SEP3**
Analyst **JDP**Sep. date **10/11/95**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.0353	0.9088	454.83	1/22/93	992	443.09189

Th-228/U-232= **0.6908113**

Counting time for Th= **1666.81** (mins.)
 Days btwn. sep. and count.= **2** (days)
 CF for Th-228= **0.9974452**

Counting time for U= **1666.81** (mins.)
 Days btwn. sep. and count.= **2** (days)
 CF for U-232= **1.0024868**

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
0	36036	513	780

U-238 counts	U-234 counts	U-232 counts
11023	11334	359

Bkgd	Bkgd	Bkgd	bkgd
0	0	0	0

bkgd	bkgd	bkgd
19	22	25

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
0	36036	472.86811	780

U-238* counts	U-234* counts	U-232sp counts
11004	11312	333.17147

U-238(dpm/g)= **376764.68** ± **20206.09**
 U-234(dpm/g)= **387310.26** ± **20762.67**

Th-232(dpm/g)= **0** ± **#DIV/0!**
 Th-230(dpm/g)= **600542.01** ± **26702.64**

U-234/U-238= **1.0279898** ± **0.013752**
 Th-230/U-234= **1.5505451** ± **0.016698**
 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)= **505035580**Th(ppb)= **0**

Spike 25A Spike 25B Spide 25C
 10/9/92
 Th-228 (dpm/g)= 3064.2209 306.09288 30.593182

U and Th Isotope Activities

FILENAME= NP4943CU.CHN
NP4943CT.CHNSample # NOPI-494-SEP3C
Analyst JDP

Sep. date 2/28/96

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.0353	3.8516	4553.22	1/22/93	1132	4419.374

Th-228/U-232= 0.7398947

Counting time for Th= 416.67 (mins.)
 Days btwn. sep. and count.= 5 (days)
 CF for Th-228= 0.9949094

Counting time for U= 416.67 (mins.)
 Days btwn. sep. and count.= 5 (days)
 CF for U-232= 1.0049547

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
0	3418	640634	128583

U-238 counts	U-234 counts	U-232 counts
3047	3079	198620

Bkgd	Bkgd	Bkgd	bkgd
0	1	1	1

bkgd	bkgd	bkgd
1	1	2

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
0	3417	637061.19	128582

U-238* counts	U-234* counts	U-232sp counts
3046	3078	197638.76

U-238(dpm/g)= 7431.646 ± 135.6609
 U-234(dpm/g)= 7509.72 ± 136.3827

Th-232(dpm/g)= 0 ± #DIV/0!
 Th-230(dpm/g)= 1913.643 ± 32.81939

U-234/U-238= 1.010506 ± 0.025822
 Th-230/U-234= 0.254822 ± 0.006331
 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)= 9961777

Th(ppb)= 0

Spike 25A Spike 25B Spide 25C
 10/9/92
 Th-228 (dpm/g)= 3269.8716 326.63585 32.646399

NP494 1AU.C HW

CB # 1 ACQ 10-13-95 AT 14:14:36 RT : 100008.6 LT : 100000.0
No detector description was entered
NOPI-494 uranophane separate 1A U 10/16/95

OI # 7-1 RANGE : 48 = 4.01MeV to 155 = 4.26MeV
AREA : Gross = 12828 Net = 12629 +/- 127
CENTROID : 128.00 = 4.19MeV
SHAPE : Fwhm = 0.07MeV Fwtm = 0.13MeV

ID : No close library match

OI # 7-2 RANGE : 290 = 4.57MeV to 408 = 4.84MeV
AREA : Gross = 13326 Net = 13088 +/- 133
CENTROID : 377.21 = 4.77MeV
SHAPE : Fwhm = 0.08MeV Fwtm = 0.14MeV

ID : No close library match

OI # 7-3 RANGE : 572 = 5.23MeV to 642 = 5.39MeV
AREA : Gross = 212 Net = 211 +/- 15
CENTROID : 619.03 = 5.34MeV
SHAPE : Fwhm = 0.02MeV Fwtm = 0.08MeV

ID : No close library match

NP4941ATH.CHW

CB # 1 ACQ 10-13-95 AT 14:14:35 RT : 100008.6 LT : 100000.0
No detector description was entered
NOPI-494 uranophane separate 1A 10/16/95

OI # 1-1 RANGE : 243 = 4.44MeV to 360 = 4.74MeV
AREA : Gross = 40114 Net = 35610 +/- 346
CENTROID : 332.86 = 4.67MeV
SHAPE : Fwhm = 0.09MeV Fwtm = 0.17MeV

ID : No close library match

OI # 1-2 RANGE : 614 = 5.38MeV to 646 = 5.46MeV
AREA : Gross = 234 Net = 145 +/- 23
CENTROID : 630.62 = 5.42MeV
SHAPE : Fwhm = 0.01MeV Fwtm = 0.05MeV

ID : No close library match

OI # 1-3 RANGE : 705 = 5.60MeV to 786 = 5.81MeV
AREA : Gross = 931 Net = 660 +/- 64
CENTROID : 755.47 = 5.73MeV
SHAPE : Fwhm = 0.01MeV Fwtm = 0.12MeV

ID : No close library match

NP494 1BU.c HW

CB # 1 ACQ 10-13-95 AT 14:14:36 RT : 100008.6 LT : 100000.0
No detector description was entered
NOPI-494 uranophane separate 1B U 10/16/95

OI # 8-1 RANGE : 38 = 3.98MeV to 159 = 4.26MeV
AREA : Gross = 14504 Net = 14115 +/- 147
CENTROID : 124.70 = 4.18MeV
SHAPE : Fwhm = 0.09MeV Fwtm = 0.15MeV

ID : No close library match

OI # 8-2 RANGE : 294 = 4.57MeV to 410 = 4.84MeV
AREA : Gross = 14903 Net = 14494 +/- 149
CENTROID : 374.05 = 4.76MeV
SHAPE : Fwhm = 0.10MeV Fwtm = 0.17MeV

ID : No close library match

OI # 8-3 RANGE : 567 = 5.21MeV to 639 = 5.38MeV
AREA : Gross = 187 Net = 187 +/- 14
CENTROID : 615.49 = 5.32MeV
SHAPE : Fwhm = 0.03MeV Fwtm = 0.10MeV

ID : No close library match

NP4941BTh.CHW

CB # 1 ACQ 10-13-95 AT 14:14:35 RT : 100008.6 LT : 100000.0
No detector description was entered
NOPI-494 uranophane separate 1B 10/16/95

OI # 2-1 RANGE : 217 = 4.35MeV to 365 = 4.73MeV
AREA : Gross = 104944 Net = 103032 +/- 385
CENTROID : 341.58 = 4.67MeV
SHAPE : Fwhm = 0.06MeV Fwtm = 0.16MeV

ID : No close library match

OI # 2-2 RANGE : 587 = 5.29MeV to 662 = 5.49MeV
AREA : Gross = 1023 Net = 935 +/- 44
CENTROID : 638.97 = 5.43MeV
SHAPE : Fwhm = 0.04MeV Fwtm = 0.14MeV

ID : No close library match

OI # 2-3 RANGE : 722 = 5.64MeV to 795 = 5.83MeV
AREA : Gross = 2084 Net = 1677 +/- 79
CENTROID : 756.71 = 5.73MeV
SHAPE : Fwhm = 0.10MeV Fwtm = 0.15MeV

ID : No close library match

NP4941C.H.W

ICB # 1 ACQ 03-07-96 AT 11:22:57 RT : 25019.7 LT : 25000.0
No detector description was entered
NOPI-494-SEP1C U 3/8/96

ROI # 7-1 RANGE : 68 = 4.05MeV to 157 = 4.26MeV
AREA : Gross = 3986 Net = 3491 +/- 102
CENTROID : 128.54 = 4.19MeV
SHAPE : Fwhm = 0.08MeV Fwtm = 0.15MeV

ID : No close library match

ROI # 7-2 RANGE : 327 = 4.66MeV to 405 = 4.84MeV
AREA : Gross = 3987 Net = 3289 +/- 109
CENTROID : 382.47 = 4.79MeV
SHAPE : Fwhm = 0.05MeV Fwtm = 0.14MeV

ID : No close library match

ROI # 7-3 RANGE : 532 = 5.13MeV to 643 = 5.39MeV
AREA : Gross = 116125 Net = 110896 +/- 451
CENTROID : 611.78 = 5.32MeV
SHAPE : Fwhm = 0.10MeV Fwtm = 0.16MeV

ID : No close library match

NP4941CT.CHW

1 ACQ 03-07-96 AT 11:22:57 RT : 20018.7 LT : 20000.0
No detector description was entered
NOPI-494-SEP1C Th 3/8/96

OI # 6-1 RANGE : 284 = 4.52MeV to 356 = 4.72MeV
AREA : Gross = 13298 Net = 12580 +/- 144
CENTROID : 338.63 = 4.68MeV
SHAPE : Fwhm = 0.04MeV Fwtm = 0.12MeV

ID : No close library match

OI # 6-2 RANGE : 540 = 5.23MeV to 627 = 5.47MeV
AREA : Gross = 431628 Net = 423987 +/- 727
CENTROID : 605.68 = 5.41MeV
SHAPE : Fwhm = 0.04MeV Fwtm = 0.13MeV

ID : No close library match

OI # 6-3 RANGE : 654 = 5.54MeV to 719 = 5.72MeV
AREA : Gross = 69375 Net = 66064 +/- 315
CENTROID : 697.84 = 5.66MeV
SHAPE : Fwhm = 0.05MeV Fwtm = 0.11MeV

ID : No close library match

NP494 2AU.CHN

CB # 1 ACQ 10-13-95 AT 14:14:37 RT : 100008.6 LT : 100000.0
No detector description was entered
NOPI-494 uranophane separate 2A U 10/16/95

OI # 9-1 RANGE : 54 = 4.00MeV to 163 = 4.26MeV
AREA : Gross = 12979 Net = 12759 +/- 129
CENTROID : 135.94 = 4.19MeV
SHAPE : Fwhm = 0.08MeV Fwtm = 0.13MeV

ID : No close library match

OI # 9-2 RANGE : 295 = 4.56MeV to 412 = 4.84MeV
AREA : Gross = 13035 Net = 12740 +/- 135
CENTROID : 384.37 = 4.77MeV
SHAPE : Fwhm = 0.08MeV Fwtm = 0.14MeV

ID : No close library match

OI # 9-3 RANGE : 588 = 5.25MeV to 640 = 5.37MeV
AREA : Gross = 286 Net = 234 +/- 25
CENTROID : 626.22 = 5.34MeV
SHAPE : Fwhm = 0.01MeV Fwtm = 0.10MeV

ID : No close library match

NP4442ATH.CHW

CI 1 ACQ 10-13-95 AT 14:14:36 RT : 100008.6 LT : 100000.0
No detector description was entered
NOPI-494 uranophane separate 2A 10/16/95

OI # 5-1 RANGE : 263 = 4.42MeV to 388 = 4.73MeV
AREA : Gross = 10849 Net = 10748 +/- 113
CENTROID : 360.00 = 4.66MeV
SHAPE : Fwhm = 0.07MeV Fwtm = 0.16MeV

ID : No close library match

OI # 5-2 RANGE : 615 = 5.31MeV to 689 = 5.50MeV
AREA : Gross = 251 Net = 177 +/- 32
CENTROID : 651.19 = 5.40MeV
SHAPE : Fwhm = 0.01MeV Fwtm = 0.04MeV

ID : No close library match

OI # 5-3 RANGE : 707 = 5.54MeV to 789 = 5.75MeV
AREA : Gross = 1330 Net = 1122 +/- 62
CENTROID : 768.00 = 5.69MeV
SHAPE : Fwhm = 0.03MeV Fwtm = 0.08MeV

ID : No close library match

NP4942BU.CHW

CP # 1 ACQ 10-13-95 AT 14:14:37 RT : 100008.6 LT : 100000.0
No detector description was entered
NOPI-494 uranophane separate 2B U 10/16/95

OI # 10-1 RANGE : 39 = 4.00MeV to 151 = 4.27MeV
AREA : Gross = 12158 Net = 12017 +/- 121
CENTROID : 120.70 = 4.20MeV
SHAPE : Fwhm = 0.07MeV Fwtm = 0.14MeV

ID : No close library match

OI # 10-2 RANGE : 286 = 4.59MeV to 399 = 4.85MeV
AREA : Gross = 12247 Net = 12116 +/- 120
CENTROID : 370.58 = 4.79MeV
SHAPE : Fwhm = 0.08MeV Fwtm = 0.15MeV

ID : No close library match

OI # 10-3 RANGE : 561 = 5.23MeV to 630 = 5.40MeV
AREA : Gross = 279 Net = 278 +/- 17
CENTROID : 610.83 = 5.35MeV
SHAPE : Fwhm = 0.01MeV Fwtm = 0.05MeV

ID : No close library match

NP4942BTh.CHN

CF 1 ACQ 10-13-95 AT 14:14:36 RT : 100008.6 LT : 100000.0
No detector description was entered
NOPI-494 uranophane separate 2B 10/16/95

OI # 6-1 RANGE : 235 = 4.39MeV to 353 = 4.71MeV
AREA : Gross = 22677 Net = 22278 +/- 173
CENTROID : 339.41 = 4.68MeV
SHAPE : Fwhm = 0.10MeV Fwtm = 0.17MeV

ID : No close library match

OI # 6-2 RANGE : 553 = 5.27MeV to 632 = 5.48MeV
AREA : Gross = 1030 Net = 415 +/- 89
CENTROID : 620.34 = 5.45MeV
SHAPE : Fwhm = 0.02MeV Fwtm = 0.08MeV

ID : No close library match

OI # 6-3 RANGE : 649 = 5.53MeV to 738 = 5.77MeV
AREA : Gross = 7964 Net = 7077 +/- 140
CENTROID : 704.23 = 5.68MeV
SHAPE : Fwhm = 0.03MeV Fwtm = 0.08MeV

ID : No close library match

NP4942CUCUW

CL # 1 ACQ 03-04-96 AT 11:27:08 RT : 25098.0 LT : 25000.0
No detector description was entered
NOPI-494-SEP2C U 3/5/96

OI # 7-1 RANGE : 73 = 4.06MeV to 155 = 4.26MeV
AREA : Gross = 3947 Net = 3408 +/- 102
CENTROID : 129.19 = 4.20MeV
SHAPE : Fwhm = 0.07MeV Fwtm = 0.14MeV

ID : No close library match

OI # 7-2 RANGE : 322 = 4.64MeV to 405 = 4.84MeV
AREA : Gross = 4270 Net = 3430 +/- 120
CENTROID : 376.72 = 4.77MeV
SHAPE : Fwhm = 0.08MeV Fwtm = 0.14MeV

ID : No close library match

OI # 7-3 RANGE : 534 = 5.14MeV to 644 = 5.39MeV
AREA : Gross = 201269 Net = 194257 +/- 563
CENTROID : 612.62 = 5.32MeV
SHAPE : Fwhm = 0.10MeV Fwtm = 0.17MeV

ID : No close library match

WP494ZCT.CH~

CB # 1 ACQ 03-04-96 AT 11:27:08 RT : 25098.0 LT : 25000.0
No detector description was entered
NOPI-494-SEP2C Th 3/5/96

OI # 4-1 RANGE : 323 = 4.57MeV to 368 = 4.69MeV
AREA : Gross = 444 Net = 76 +/- 50
Could not properly fit the peak.

OI # 4-2 RANGE : 579 = 5.26MeV to 672 = 5.52MeV
AREA : Gross = 766614 Net = 755240 +/- 960
CENTROID : 648.92 = 5.45MeV
SHAPE : Fwhm = 0.04MeV Fwtm = 0.14MeV

ID : No close library match

OI # 4-3 RANGE : 689 = 5.56MeV to 767 = 5.77MeV
AREA : Gross = 160704 Net = 154278 +/- 482
CENTROID : 742.95 = 5.71MeV
SHAPE : Fwhm = 0.07MeV Fwtm = 0.13MeV

ID : No close library match

NP4443AU.CHW

CP # 1 ACQ 10-13-95 AT 14:14:37 RT : 100008.6 LT : 100000.0
No detector description was entered
NOPI-494 uranophane separate 3A U 10/16/95

OI # 11-1 RANGE : 69 = 4.04MeV to 166 = 4.26MeV
AREA : Gross = 9314 Net = 9313 +/- 97
CENTROID : 140.06 = 4.20MeV
SHAPE : Fwhm = 0.06MeV Fwtm = 0.13MeV

ID : No close library match

OI # 11-2 RANGE : 306 = 4.58MeV to 414 = 4.83MeV
AREA : Gross = 9676 Net = 9545 +/- 109
CENTROID : 389.43 = 4.78MeV
SHAPE : Fwhm = 0.08MeV Fwtm = 0.14MeV

ID : No close library match

OI # 11-3 RANGE : 574 = 5.20MeV to 647 = 5.37MeV
AREA : Gross = 285 Net = 284 +/- 17
CENTROID : 630.10 = 5.33MeV
SHAPE : Fwhm = 0.00MeV Fwtm = 0.10MeV

ID : No close library match

NP4943ATH.CHW

CB # 2 ACQ 10-13-95 AT 14:15:17 RT : 111013.7 LT : 100000.0
No detector description was entered
NOPI-494 uranophane separate 3A Th 10/16/95

OI # 1-1 RANGE : 564 = 4.50MeV to 717 = 4.71MeV
AREA : Gross = 13313 Net = 12851 +/- 156
CENTROID : 686.97 = 4.67MeV
SHAPE : Fwhm = 0.04MeV Fwtm = 0.13MeV

ID : No close library match

OI # 1-2 RANGE : 1128 = 5.27MeV to 1262 = 5.46MeV
AREA : Gross = 256 Net = 256 +/- 16
CENTROID : 1243.62 = 5.43MeV
SHAPE : Fwhm = 0.01MeV Fwtm = 0.05MeV

ID : No close library match

OI # 1-3 RANGE : 1405 = 5.65MeV to 1513 = 5.80MeV
AREA : Gross = 358 Net = 303 +/- 35
CENTROID : 1447.43 = 5.71MeV
SHAPE : Fwhm = 0.00MeV Fwtm = 0.06MeV

ID : No close library match

NP4943BU.CHW

CP # 1 ACQ 10-13-95 AT 14:14:37 RT : 100008.6 LT : 100000.0
No detector description was entered
NOPI-494 uranophane separate 3B U10/16/95

OI # 12-1 RANGE : 40 = 3.97MeV to 167 = 4.26MeV
AREA : Gross = 11326 Net = 11023 +/- 131
CENTROID : 134.51 = 4.19MeV
SHAPE : Fwhm = 0.08MeV Fwtm = 0.14MeV

ID : No close library match

OI # 12-2 RANGE : 289 = 4.55MeV to 420 = 4.85MeV
AREA : Gross = 11598 Net = 11334 +/- 130
CENTROID : 383.64 = 4.77MeV
SHAPE : Fwhm = 0.09MeV Fwtm = 0.15MeV

ID : No close library match

OI # 12-3 RANGE : 570 = 5.20MeV to 645 = 5.37MeV
AREA : Gross = 359 Net = 359 +/- 19
CENTROID : 624.00 = 5.32MeV
SHAPE : Fwhm = 0.00MeV Fwtm = 0.10MeV

ID : No close library match

NP4943BTh.CHN

2 ACQ 10-13-95 AT 14:15:18 RT : 111013.7 LT : 100000.0
No detector description was entered
NOPI-494 uranophane separate 3B Th 10/16/95

ROI # 2-1 RANGE : 510 = 4.41MeV to 739 = 4.71MeV
AREA : Gross = 37186 Net = 36036 +/- 281
CENTROID : 700.38 = 4.66MeV
SHAPE : Fwhm = 0.10MeV Fwtm = 0.18MeV

ID : No close library match

ROI # 2-2 RANGE : 1155 = 5.27MeV to 1296 = 5.45MeV
AREA : Gross = 653 Net = 513 +/- 61
CENTROID : 1263.01 = 5.41MeV
SHAPE : Fwhm = 0.01MeV Fwtm = 0.06MeV

ID : No close library match

ROI # 2-3 RANGE : 1390 = 5.58MeV to 1553 = 5.80MeV
AREA : Gross = 944 Net = 780 +/- 71
CENTROID : 1507.28 = 5.74MeV
SHAPE : Fwhm = 0.01MeV Fwtm = 0.10MeV

ID : No close library match

NP494324.cfw

ICB # 1 ACQ 03-04-96 AT 11:27:09 RT : 25098.0 LT : 25000.0
No detector description was entered
NOPI-494-SEP3C U 3/5/96

ROI # 8-1 RANGE : 70 = 4.05MeV to 156 = 4.25MeV
AREA : Gross = 4960 Net = 3047 +/- 170
CENTROID : 126.81 = 4.18MeV
SHAPE : Fwhm = 0.09MeV Fwtm = 0.14MeV

ID : No close library match

ROI # 8-2 RANGE : 326 = 4.65MeV to 409 = 4.84MeV
AREA : Gross = 5852 Net = 3079 +/- 198
CENTROID : 375.65 = 4.76MeV
SHAPE : Fwhm = 0.09MeV Fwtm = 0.16MeV

ID : No close library match

ROI # 8-3 RANGE : 544 = 5.16MeV to 646 = 5.39MeV
AREA : Gross = 214119 Net = 198620 +/- 670
CENTROID : 612.15 = 5.31MeV
SHAPE : Fwhm = 0.10MeV Fwtm = 0.17MeV

ID : No close library match

NP4943CT.CHW

ICB # 1 ACQ 03-04-96 AT 11:27:08 RT : 25098.0 LT : 25000.0
No detector description was entered
NOPI-494-SEP3C Th 3/5/96

ROI # 5-1 RANGE : 320 = 4.56MeV to 386 = 4.73MeV
AREA : Gross = 4011 Net = 3418 +/- 97
CENTROID : 370.59 = 4.69MeV
SHAPE : Fwhm = 0.04MeV Fwtm = 0.11MeV

ID : No close library match

ROI # 5-2 RANGE : 597 = 5.26MeV to 696 = 5.51MeV
AREA : Gross = 654335 Net = 640634 +/- 925
CENTROID : 672.87 = 5.45MeV
SHAPE : Fwhm = 0.04MeV Fwtm = 0.14MeV

ID : No close library match

ROI # 5-3 RANGE : 720 = 5.57MeV to 798 = 5.77MeV
AREA : Gross = 135285 Net = 128583 +/- 458
CENTROID : 774.71 = 5.71MeV
SHAPE : Fwhm = 0.06MeV Fwtm = 0.12MeV

ID : No close library match

U and Th Isotope Activities

FILENAME= NP4944U.CHN
NP4944TH.CHN

Sample # **NOPI-494-SEP4**
Analyst **JDP**

Sep. date **2/28/96**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.035	3.3388	4553.22	1/22/93	1132	4419.374

Th-228/U-232= **0.7398947**

Counting time for Th=	416.67	(mins.)	Counting time for U=	416.67	(mins.)
Days btwn. sep. and count.=	5	(days)	Days btwn. sep. and count.=	5	(days)
CF for Th-228=	0.9949094		CF for U-232=	1.0049547	

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
0	19561	582739	114398

U-238 counts	U-234 counts	U-232 counts
3322	3223	132973

Bkgd	Bkgd	Bkgd	bkgd
0	8	1	0

bkgd	bkgd	bkgd
1	1	5

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
0	19553	579625.56	114398

U-238* counts	U-234* counts	U-232sp counts
3321	3222	132312.43

U-238(dpm/g)= **10581.6** ± **185.8702**
U-234(dpm/g)= **10266.16** ± **183.0115**

Th-232(dpm/g)= **0** ± **#DIV/0!**
Th-230(dpm/g)= **10522.5** ± **76.48791**

U-234/U-238= **0.97019** ± **0.023987**
Th-230/U-234= **1.024969** ± **0.019485**
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)= **14184144**

Th(ppb)= **0**

Spike 25A Spike 25B Spide 25C
10/9/92
Th-228 (dpm/g)= 3269.8716 326.63585 32.646399

U and Th Isotope Activities

FILENAME= NP4945U.CHN
NP4945TH.CHN

Sample # **NOPI-494-SEP5**
Analyst **JDP**

Sep. date **2/28/96**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.0296	3.8403	4553.22	1/22/93	1132	4419.374

Th-228/U-232= **0.7398947**

Counting time for Th= **416.67** (mins.)
Days btwn. sep. and count.= **5** (days)
CF for Th-228= **0.9949094**

Counting time for U= **416.67** (mins.)
Days btwn. sep. and count.= **5** (days)
CF for U-232= **1.0049547**

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
0	10232	379662	91066

U-238 counts	U-234 counts	U-232 counts
3555	3533	201015

Bkgd	Bkgd	Bkgd	bkgd
0	1	2	8

bkgd	bkgd	bkgd
1	1	6

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
0	10231	376751.82	91058

U-238* counts	U-234* counts	U-232sp counts
3554	3532	200017.98

U-238(dpm/g)= **10187.85** ± **172.3731**
U-234(dpm/g)= **10124.79** ± **171.8294**

Th-232(dpm/g)= **0** ± **#DIV/0!**
Th-230(dpm/g)= **11520.38** ± **115.4147**

U-234/U-238= **0.99381** ± **0.023609**
Th-230/U-234= **1.137839** ± **0.022203**
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)= **13656342**

Th(ppb)= **0**

Spike 25A Spike 25B Spide 25C
10/9/92
Th-228 (dpm/g)= **3269.8716** **326.63585** **32.646399**

U and Th Isotope Activities

FILENAME= NP4946U.CHN
NP4946TH.CHN

Sample # **NOPI-494-SEP6**
Analyst **JDP**

Sep. date **2/28/96**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.0481	3.8203	4553.22	1/22/93	1132	4419.374

Th-228/U-232= **0.7398947**

Counting time for Th= **416.67** (mins.)
Days btwn. sep. and count.= **5** (days)
CF for Th-228= **0.9949094**

Counting time for U= **416.67** (mins.)
Days btwn. sep. and count.= **5** (days)
CF for U-232= **1.0049547**

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
0	36019	664688	136009

U-238 counts	U-234 counts	U-232 counts
2414	2268	63494

Bkgd	Bkgd	Bkgd	bkgd
0	2	5	5

bkgd	bkgd	bkgd
2	3	8

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
0	36017	660838.86	136004

U-238* counts	U-234* counts	U-232sp counts
2412	2265	63172.998

U-238(dpm/g)= **13401.67** ± **277.9029**
U-234(dpm/g)= **12584.9** ± **268.9364**

Th-232(dpm/g)= **0** ± **#DIV/0!**
Th-230(dpm/g)= **14154.52** ± **76.57527**

U-234/U-238= **0.939055** ± **0.027461**
Th-230/U-234= **1.124722** ± **0.024349**
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)= **17964319**

Th(ppb)= **0**

Spike 25A Spike 25B Spide 25C
10/9/92
Th-228 (dpm/g)= **3269.8716** **326.63585** **32.646399**

NP49444.CHN

ICB # 1 ACQ 03-04-96 AT 11:27:09 RT : 25098.0 LT : 25000.0
No detector description was entered
NOPI-494-SEP4 U 3/5/96

ROI # 9-1 RANGE : 86 = 4.08MeV to 158 = 4.24MeV
AREA : Gross = 4065 Net = 3322 +/- 108
CENTROID : 134.67 = 4.19MeV
SHAPE : Fwhm = 0.08MeV Fwtm = 0.13MeV

ID : No close library match

ROI # 9-2 RANGE : 337 = 4.66MeV to 412 = 4.84MeV
AREA : Gross = 4553 Net = 3223 +/- 137
CENTROID : 384.61 = 4.77MeV
SHAPE : Fwhm = 0.07MeV Fwtm = 0.13MeV

ID : No close library match

ROI # 9-3 RANGE : 567 = 5.20MeV to 649 = 5.39MeV
AREA : Gross = 147358 Net = 132973 +/- 564
CENTROID : 619.32 = 5.32MeV
SHAPE : Fwhm = 0.10MeV Fwtm = 0.15MeV

ID : No close library match

WP4944Th.cHW

ICB # 1 ACQ 03-04-96 AT 11:27:08 RT : 25098.0 LT : 25000.0
No detector description was entered
NOPI-494-SEP4 Th 3/5/96

ROI # 6-1 RANGE : 278 = 4.51MeV to 355 = 4.72MeV
AREA : Gross = 20042 Net = 19561 +/- 159
CENTROID : 337.95 = 4.67MeV
SHAPE : Fwhm = 0.04MeV Fwtm = 0.12MeV

ID : No close library match

ROI # 6-2 RANGE : 540 = 5.23MeV to 627 = 5.47MeV
AREA : Gross = 590879 Net = 582739 +/- 833
CENTROID : 605.10 = 5.41MeV
SHAPE : Fwhm = 0.04MeV Fwtm = 0.13MeV

ID : No close library match

ROI # 6-3 RANGE : 644 = 5.52MeV to 718 = 5.72MeV
AREA : Gross = 118198 Net = 114398 +/- 398
CENTROID : 694.36 = 5.65MeV
SHAPE : Fwhm = 0.06MeV Fwtm = 0.11MeV

ID : No close library match

NP494Su.c HW

ICB # 1 ACQ 03-04-96 AT 11:27:09 RT : 25098.0 LT : 25000.0
No detector description was entered
NOPI-494-SEP5 U 3/5/96

ROI # 10-1 RANGE : 66 = 4.07MeV to 146 = 4.26MeV
AREA : Gross = 4353 Net = 3555 +/- 116
CENTROID : 121.76 = 4.20MeV
SHAPE : Fwhm = 0.08MeV Fwtm = 0.14MeV

ID : No close library match

ROI # 10-2 RANGE : 321 = 4.67MeV to 395 = 4.84MeV
AREA : Gross = 4533 Net = 3533 +/- 123
CENTROID : 373.82 = 4.79MeV
SHAPE : Fwhm = 0.10MeV Fwtm = 0.15MeV

ID : No close library match

ROI # 10-3 RANGE : 542 = 5.19MeV to 637 = 5.41MeV
AREA : Gross = 224378 Net = 201015 +/- 743
CENTROID : 606.49 = 5.34MeV
SHAPE : Fwhm = 0.10MeV Fwtm = 0.17MeV

ID : No close library match

NP4945Th.cfw

ICB # 2 ACQ 03-04-96 AT 11:26:53 RT : 25046.7 LT : 25000.0
No detector description was entered
NOPI-494-SEP5 Th 3/5/96

ROI # 1-1 RANGE : 591 = 4.54MeV to 722 = 4.72MeV
AREA : Gross = 10727 Net = 10232 +/- 144
CENTROID : 692.86 = 4.68MeV
SHAPE : Fwhm = 0.04MeV Fwtm = 0.12MeV

ID : No close library match

ROI # 1-2 RANGE : 1105 = 5.24MeV to 1281 = 5.48MeV
AREA : Gross = 385618 Net = 379662 +/- 741
CENTROID : 1246.11 = 5.44MeV
SHAPE : Fwhm = 0.03MeV Fwtm = 0.07MeV

ID : No close library match

ROI # 1-3 RANGE : 1346 = 5.57MeV to 1470 = 5.74MeV
AREA : Gross = 96525 Net = 91066 +/- 446
CENTROID : 1430.28 = 5.69MeV
SHAPE : Fwhm = 0.07MeV Fwtm = 0.12MeV

ID : No close library match

NP4946u.c.Hw

ICB # 1 ACQ 03-04-96 AT 11:27:09 RT : 25098.0 LT : 25000.0
No detector description was entered
NOPI-494-SEP6 U 3/5/96

ROI # 11-1 RANGE : 78 = 4.06MeV to 163 = 4.25MeV
AREA : Gross = 3247 Net = 2414 +/- 116
CENTROID : 137.42 = 4.20MeV
SHAPE : Fwhm = 0.06MeV Fwtm = 0.12MeV

ID : No close library match

ROI # 11-2 RANGE : 340 = 4.66MeV to 414 = 4.83MeV
AREA : Gross = 4050 Net = 2268 +/- 151
CENTROID : 392.62 = 4.78MeV
SHAPE : Fwhm = 0.05MeV Fwtm = 0.14MeV

ID : No close library match

ROI # 11-3 RANGE : 564 = 5.18MeV to 655 = 5.39MeV
AREA : Gross = 76374 Net = 63494 +/- 498
CENTROID : 625.61 = 5.32MeV
SHAPE : Fwhm = 0.10MeV Fwtm = 0.15MeV

ID : No close library match

NP4946 Th. CTH

ICB # 2 ACQ 03-04-96 AT 11:26:54 RT : 25046.7 LT : 25000.0
No detector description was entered
NOPI-494-SEP6 Th 3/5/96

ROI # 2-1 RANGE : 589 = 4.51MeV to 739 = 4.71MeV
AREA : Gross = 37228 Net = 36019 +/- 255
CENTROID : 709.23 = 4.67MeV
SHAPE : Fwhm = 0.04MeV Fwtm = 0.13MeV

ID : No close library match

ROI # 2-2 RANGE : 1127 = 5.23MeV to 1307 = 5.47MeV
AREA : Gross = 688580 Net = 664688 +/- 1167
CENTROID : 1270.06 = 5.42MeV
SHAPE : Fwhm = 0.04MeV Fwtm = 0.14MeV

ID : No close library match

ROI # 2-3 RANGE : 1348 = 5.52MeV to 1499 = 5.72MeV
AREA : Gross = 147003 Net = 136009 +/- 635
CENTROID : 1453.60 = 5.66MeV
SHAPE : Fwhm = 0.08MeV Fwtm = 0.14MeV

ID : No close library match

U and Th Isotope Activities

FILENAME= NP137U5.CHN
NP137TH5.CHN

Sample # **NOPI-137**
Analyst **JDP**

Sep. date **3/20/95**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.2548	0.5055	454.83	1/22/93	787	445.49251

Th-228/U-232= **0.6072609**

Counting time for Th= **1000.03** (mins.)
Days btwn. sep. and count.= **4** (days)
CF for Th-228= **0.9956968**

Counting time for U= **666.723** (mins.)
Days btwn. sep. and count.= **3** (days)
CF for U-232= **1.0031153**

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
102	10982	5739	1890

U-238 counts	U-234 counts	U-232 counts
8645	10067	8886

Bkgd	Bkgd	Bkgd	bkgd
3	8	14	25

bkgd	bkgd	bkgd
8	7	4

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
99	10974	5551.4703	1865

U-238* counts	U-234* counts	U-232sp counts
8637	10060	8854.4162

U-238(dpm/g)= **862.11487** ± **13.02365**
U-234(dpm/g)= **1004.1537** ± **14.61625**

Th-232(dpm/g)= **9.5711613** ± **0.956071**
Th-230(dpm/g)= **1060.9487** ± **17.28091**

U-234/U-238= **1.1647563** ± **0.017079**
Th-230/U-234= **1.0565601** ± **0.014579**
Th-230/Th-232= **110.84848** ± **11.02649**
U234/Th-232= **104.91451** ± **10.59067**

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

U(ppb)= **1155625**

Th(ppb)= **39171.154**

Spike 25A Spike 25B Spide 25C
10/9/92
Th-228 (dpm/g)= 2708.2115 270.53018 27.038784

NP137US.CHN

MCB # 1 ACQ 03-23-95 AT 16:08:30 RT : 40003.4 LT : 40000.0
No detector description was entered
NOPI-137 U 3/24/95

ROI # 1-1 RANGE : 50 to 164
AREA : Gross = 8914 Net = 8645 +/- 116
CENTROID : 140.76
SHAPE : Fwhm = 41.64 Channels Fwtm = 79.47 Channels

ROI # 1-2 RANGE : 288 to 387
AREA : Gross = 10767 Net = 10067 +/- 145
CENTROID : 368.84
SHAPE : Fwhm = 47.18 Channels Fwtm = 78.19 Channels

ROI # 1-3 RANGE : 532 to 605
AREA : Gross = 11132 Net = 8886 +/- 185
CENTROID : 589.53
SHAPE : Fwhm = 36.31 Channels Fwtm = 60.07 Channels

NP137 Th 5.c#w

MCB # 1 ACQ 03-24-95 AT 16:08:42 RT : 60001.7 LT : 60000.0
No detector description was entered
NOPI-137 Th 3/27/95

ROI # 1-1 RANGE : 33 to 84
AREA : Gross = 128 Net = 102 +/- 17
CENTROID : 69.36
SHAPE : Fwhm = 9.57 Channels Fwtm = 17.34 Channels

ROI # 1-2 RANGE : 257 to 353
AREA : Gross = 11273 Net = 10982 +/- 124
CENTROID : 336.20
SHAPE : Fwhm = 16.14 Channels Fwtm = 53.92 Channels

ROI # 1-3 RANGE : 564 to 650
AREA : Gross = 6088 Net = 5739 +/- 102
CENTROID : 631.79
SHAPE : Fwhm = 16.94 Channels Fwtm = 58.68 Channels

ROI # 1-4 RANGE : 678 to 755
AREA : Gross = 2241 Net = 1890 +/- 78
CENTROID : 732.68
SHAPE : Fwhm = 26.93 Channels Fwtm = 55.63 Channels

U and Th Isotope Activities

FILENAME= NP139U5.CHN
NP139TH5.CHNSample # **NOPI-139**
Analyst **JDP**Sep. date **3/20/95**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.3173	0.5041	454.83	1/22/93	787	445.49251

Th-228/U-232= **0.6072609**

Counting time for Th= **1000.03** (mins.)
 Days btwn. sep. and count.= **4** (days)
 CF for Th-228= **0.9956968**

Counting time for U= **666.723** (mins.)
 Days btwn. sep. and count.= **3** (days)
 CF for U-232= **1.0031153**

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
129	30784	9133	2783

U-238 counts	U-234 counts	U-232 counts
8820	10049	5946

Bkgd	Bkgd	Bkgd	bkgd
2	3	11	19

bkgd	bkgd	bkgd
2	4	4

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
127	30781	8887.2986	2764

U-238* counts	U-234* counts	U-232sp counts
8818	10045	5923.5466

U-238(dpm/g)= **1053.5989** ± **17.67909**
 U-234(dpm/g)= **1200.2043** ± **19.63692**

Th-232(dpm/g)= **6.1418089** ± **0.544562**
 Th-230(dpm/g)= **1488.5907** ± **17.7372**

U-234/U-238= **1.1391472** ± **0.016621**
 Th-230/U-234= **1.2402811** ± **0.01425**
 Th-230/Th-232= **242.37008** ± **21.38416**
 U234/Th-232= **195.41544** ± **17.61898**

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

U(ppb)= **1412300.5**Th(ppb)= **25136.108**

Spike 25A Spike 25B Spide 25C
 10/9/92
 Th-228 (dpm/g)= 2708.2115 270.53018 27.038784

NP139U5.CHW

MCB # 1 ACQ 03-23-95 AT 16:08:31 RT : 40003.4 LT : 40000.0
No detector description was entered
NOPI-139 U 3/24/95

ROI # 2-1 RANGE : 55 to 169
AREA : Gross = 8994 Net = 8820 +/- 109
CENTROID : 144.81
SHAPE : Fwhm = 35.89 Channels Fwtm = 74.21 Channels

ROI # 2-2 RANGE : 293 to 397
AREA : Gross = 10295 Net = 10049 +/- 119
CENTROID : 372.84
SHAPE : Fwhm = 38.04 Channels Fwtm = 75.04 Channels

ROI # 2-3 RANGE : 519 to 614
AREA : Gross = 6378 Net = 5946 +/- 111
CENTROID : 588.81
SHAPE : Fwhm = 41.69 Channels Fwtm = 66.23 Channels

NP139TAS.CHW

MCB # 1 ACQ 03-24-95 AT 16:08:42 RT : 60001.7 LT : 60000.0
No detector description was entered
NOPI-139 Th 3/27/95

ROI # 2-1 RANGE : 31 to 89
AREA : Gross = 130 Net = 129 +/- 12
CENTROID : 75.91
SHAPE : Fwhm = 3.47 Channels Fwtm = 24.07 Channels

ROI # 2-2 RANGE : 267 to 362
AREA : Gross = 31024 Net = 30784 +/- 185
CENTROID : 342.27
SHAPE : Fwhm = 16.51 Channels Fwtm = 49.69 Channels

ROI # 2-3 RANGE : 576 to 660
AREA : Gross = 9456 Net = 9133 +/- 116
CENTROID : 638.35
SHAPE : Fwhm = 14.67 Channels Fwtm = 53.65 Channels

ROI # 2-4 RANGE : 680 to 761
AREA : Gross = 3357 Net = 2783 +/- 100
CENTROID : 738.87
SHAPE : Fwhm = 24.95 Channels Fwtm = 48.03 Channels

U and Th Isotope Activities

FILENAME= NP142U5.CHN
NP142TH5.CHNSample # **NOPI-142**
Analyst **JDP**Sep. date **3/20/95**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.3726	0.5054	454.83	1/22/93	787	445.49251

Th-228/U-232= **0.6072609**

Counting time for Th= **1000.058** (mins.)
 Days btwn. sep. and count.= **7** (days)
 CF for Th-228= **0.9927379**

Counting time for U= **666.723** (mins.)
 Days btwn. sep. and count.= **3** (days)
 CF for U-232= **1.0031153**

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
844	52394	10084	4977

U-238 counts	U-234 counts	U-232 counts
6302	8810	2982

Bkgd	Bkgd	Bkgd	bkgd
5	10	14	26

bkgd	bkgd	bkgd
7	9	6

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
839	52384	9040.3417	4951

U-238* counts	U-234* counts	U-232sp counts
6295	8801	2966.7578

U-238(dpm/g)= **1282.1725** ± **28.49843**
 U-234(dpm/g)= **1792.5973** ± **37.97823**

Th-232(dpm/g)= **34.055341** ± **1.220304**
 Th-230(dpm/g)= **2126.2872** ± **23.12215**

U-234/U-238= **1.3980937** ± **0.023066**
 Th-230/U-234= **1.1861489** ± **0.013658**
 Th-230/Th-232= **62.436234** ± **2.166385**
 U234/Th-232= **52.637772** ± **2.191182**

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

U(ppb)= **1718692.7**Th(ppb)= **139375.67**

Spike 25A Spike 25B Spide 25C
 10/9/92
 Th-228 (dpm/g)= 2708.2115 270.53018 27.038784

NP142U5.CHW

MCB # 1 ACQ 03-23-95 AT 16:08:31 RT : 40003.4 LT : 40000.0
No detector description was entered
NOPI-142 U 3/24/95

ROI # 7-1 RANGE : 42 to 151
AREA : Gross = 6549 Net = 6302 +/- 103
CENTROID : 121.12
SHAPE : Fwhm = 38.02 Channels Fwtm = 75.50 Channels

ROI # 7-2 RANGE : 291 to 402
AREA : Gross = 9052 Net = 8810 +/- 114
CENTROID : 368.67
SHAPE : Fwhm = 43.82 Channels Fwtm = 71.68 Channels

ROI # 7-3 RANGE : 555 to 639
AREA : Gross = 3338 Net = 2982 +/- 88
CENTROID : 605.70
SHAPE : Fwhm = 40.76 Channels Fwtm = 68.07 Channels

NP142ThS-ctw

MCB # 1 ACQ 03-27-95 AT 08:55:41 RT : 60003.5 LT : 60000.0
No detector description was entered
NOPI-142 Th 3/28/95

ROI # 1-1 RANGE : 21 to 86
AREA : Gross = 1009 Net = 844 +/- 50
CENTROID : 68.78
SHAPE : Fwhm = 20.10 Channels Fwtm = 36.75 Channels

ROI # 1-2 RANGE : 206 to 352
AREA : Gross = 52908 Net = 52394 +/- 254
CENTROID : 333.12
SHAPE : Fwhm = 36.11 Channels Fwtm = 63.54 Channels

ROI # 1-3 RANGE : 547 to 651
AREA : Gross = 11168 Net = 10084 +/- 167
CENTROID : 629.39
SHAPE : Fwhm = 21.17 Channels Fwtm = 62.89 Channels

ROI # 1-4 RANGE : 669 to 754
AREA : Gross = 6323 Net = 4977 +/- 151
CENTROID : 730.61
SHAPE : Fwhm = 35.07 Channels Fwtm = 69.27 Channels

U and Th Isotope Activities

FILENAME= NP144U5.CHN
NP144TH5.CHN

Sample # **NOPI-144**
Analyst **JDP**

Sep. date **3/20/95**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.251	0.5048	454.83	1/22/93	787	445.49251

Th-228/U-232= **0.6072609**

Counting time for Th= **1000.058** (mins.)
Days btwn. sep. and count.= **7** (days)
CF for Th-228= **0.9927379**

Counting time for U= **666.723** (mins.)
Days btwn. sep. and count.= **3** (days)
CF for U-232= **1.0031153**

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
53	53160	6289	3881

U-238 counts	U-234 counts	U-232 counts
5620	6483	1265

Bkgd	Bkgd	Bkgd	bkgd
2	4	11	19

bkgd	bkgd	bkgd
4	5	6

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
51	53156	6066.7416	3862

U-238* counts	U-234* counts	U-232sp counts
5616	6478	1255.0901

U-238(dpm/g)= **4009.0202** ± **124.7604**
U-234(dpm/g)= **4624.3648** ± **142.1391**

Th-232(dpm/g)= **4.573788** ± **0.6309**
Th-230(dpm/g)= **4767.1426** ± **63.56926**

U-234/U-238= **1.15349** ± **0.021023**
Th-230/U-234= **1.0308751** ± **0.013561**
Th-230/Th-232= **1042.2745** ± **143.2388**
U234/Th-232= **1011.058** ± **142.884**

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

U(ppb)= **5373905.6**

Th(ppb)= **18718.789**

Spike 25A Spike 25B Spide 25C
10/9/92
Th-228 (dpm/g)= 2708.2115 270.53018 27.038784

NP144US.CHW

MCB # 1 ACQ 03-23-95 AT 16:08:32 RT : 40003.4 LT : 40000.0
No detector description was entered
NOPI-144 U 3/24/95

ROI # 8-1 RANGE : 50 to 150
AREA : Gross = 6093 Net = 5620 +/- 114
CENTROID : 118.11
SHAPE : Fwhm = 44.46 Channels Fwtm = 75.98 Channels

ROI # 8-2 RANGE : 294 to 401
AREA : Gross = 6898 Net = 6483 +/- 116
CENTROID : 368.01
SHAPE : Fwhm = 48.20 Channels Fwtm = 74.79 Channels

ROI # 8-3 RANGE : 563 to 636
AREA : Gross = 1574 Net = 1265 +/- 69
CENTROID : 609.36
SHAPE : Fwhm = 37.83 Channels Fwtm = 54.91 Channels

N P144TH5.CHW

MCB # 1 ACQ 03-27-95 AT 08:55:41 RT : 60003.5 LT : 60000.0
No detector description was entered
NOPI-144 Th 3/28/95

ROI # 2-1 RANGE : 20 to 86
AREA : Gross = 118 Net = 53 +/- 27
CENTROID : 64.00
SHAPE : Fwhm = 1.67 Channels Fwtm = 6.25 Channels

ROI # 2-2 RANGE : 221 to 361
AREA : Gross = 54051 Net = 53160 +/- 271
CENTROID : 342.56
SHAPE : Fwhm = 17.41 Channels Fwtm = 56.20 Channels

ROI # 2-3 RANGE : 561 to 657
AREA : Gross = 6822 Net = 6289 +/- 120
CENTROID : 638.91
SHAPE : Fwhm = 16.35 Channels Fwtm = 57.36 Channels

ROI # 2-4 RANGE : 677 to 768
AREA : Gross = 4985 Net = 3881 +/- 140
CENTROID : 741.54
SHAPE : Fwhm = 28.41 Channels Fwtm = 55.86 Channels

U and Th Isotope Activities

FILENAME= NP205U5.CHN
NP205TH5.CHN

Sample # **NOPI-205**
Analyst **JDP**

Sep. date **3/20/95**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.2548	0.5064	454.83	1/22/93	787	445.49251

Th-228/U-232= **0.6072609**

Counting time for Th= **1000.03** (mins.)
Days btwn. sep. and count.= **8** (days)
CF for Th-228= **0.9917536**

Counting time for U= **666.723** (mins.)
Days btwn. sep. and count.= **3** (days)
CF for U-232= **1.0031153**

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
443	12932	9658	6160

U-238 counts	U-234 counts	U-232 counts
5550	6187	8085

Bkgd	Bkgd	Bkgd	bkgd
4	7	16	26

bkgd	bkgd	bkgd
1	3	6

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
439	12925	8955.3678	6134

U-238* counts	U-234* counts	U-232sp counts
5549	6184	8053.9099

U-238(dpm/g)= **610.01798** ± **10.63368**
U-234(dpm/g)= **679.82541** ± **11.48312**

Th-232(dpm/g)= **26.356704** ± **1.280642**
Th-230(dpm/g)= **775.99179** ± **10.43611**

U-234/U-238= **1.114435** ± **0.020604**
Th-230/U-234= **1.1414575** ± **0.017645**
Th-230/Th-232= **29.441913** ± **1.422585**
U234/Th-232= **25.793264** ± **1.326835**

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

U(ppb)= **817700.81**

Th(ppb)= **107868.05**

Spike 25A Spike 25B Spide 25C
10/9/92
Th-228 (dpm/g)= 2708.2115 270.53018 27.038784

NP205U5.cfw

MCB # 1 ACQ 03-23-95 AT 16:08:32 RT : 40003.4 LT : 40000.0
No detector description was entered
NOPI-205 U 3/24/95

ROI # 9-1 RANGE : 52 to 159
AREA : Gross = 5551 Net = 5550 +/- 75
CENTROID : 129.81
SHAPE : Fwhm = 41.00 Channels Fwtm = 62.94 Channels

ROI # 9-2 RANGE : 307 to 409
AREA : Gross = 6274 Net = 6187 +/- 87
CENTROID : 379.49
SHAPE : Fwhm = 40.45 Channels Fwtm = 66.08 Channels

ROI # 9-3 RANGE : 560 to 641
AREA : Gross = 8796 Net = 8085 +/- 131
CENTROID : 614.11
SHAPE : Fwhm = 41.59 Channels Fwtm = 61.85 Channels

NP205Th5.cfw

■ MCB # 1 ACQ 03-28-95 AT 08:06:33 RT : 60001.8 LT : 60000.0
No detector description was entered
NOPI-205 Th 3/29/95

ROI # 1-1 RANGE : 20 to 84
AREA : Gross = 444 Net = 443 +/- 21
CENTROID : 69.59
SHAPE : Fwhm = 13.12 Channels Fwtm = 26.41 Channels

ROI # 1-2 RANGE : 230 to 354
AREA : Gross = 13162 Net = 12932 +/- 132
CENTROID : 335.43
SHAPE : Fwhm = 18.00 Channels Fwtm = 52.38 Channels

ROI # 1-3 RANGE : 561 to 652
AREA : Gross = 10505 Net = 9658 +/- 148
CENTROID : 631.84
SHAPE : Fwhm = 17.15 Channels Fwtm = 56.51 Channels

ROI # 1-4 RANGE : 667 to 755
AREA : Gross = 6739 Net = 6160 +/- 119
CENTROID : 734.34
SHAPE : Fwhm = 26.31 Channels Fwtm = 53.75 Channels

U and Th Isotope Activities

FILENAME= NP209U5.CHN
NP209TH5.CHN

Sample # **NOPI-209**
Analyst **JDP**

Sep. date **3/20/95**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.095	0.5064	454.83	1/22/93	787	445.49251

Th-228/U-232= **0.6072609**

Counting time for Th= **1000.03** (mins.)
Days btwn. sep. and count.= **8** (days)
CF for Th-228= **0.9917536**

Counting time for U= **666.723** (mins.)
Days btwn. sep. and count.= **3** (days)
CF for U-232= **1.0031153**

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
152	8621	10260	6249

U-238 counts	U-234 counts	U-232 counts
2943	4394	10228

Bkgd	Bkgd	Bkgd	bkgd
3	3	12	18

bkgd	bkgd	bkgd
2	1	6

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
149	8618	9851.2229	6231

U-238* counts	U-234* counts	U-232sp counts
2941	4393	10190.255

U-238(dpm/g)= **685.36274** ± **14.33638**
U-234(dpm/g)= **1023.7329** ± **18.46565**

Th-232(dpm/g)= **21.81132** ± **1.782188**
Th-230(dpm/g)= **1261.5433** ± **18.43156**

U-234/U-238= **1.4937096** ± **0.03558**
Th-230/U-234= **1.2322973** ± **0.022842**
Th-230/Th-232= **57.838926** ± **4.732533**
U234/Th-232= **46.935854** ± **3.927431**

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

U(ppb)= **918696.95**

Th(ppb)= **89265.506**

Spike 25A Spike 25B Spide 25C
10/9/92
Th-228 (dpm/g)= 2708.2115 270.53018 27.038784

NP209U5.CHW

MCB # 1 ACQ 03-23-95 AT 16:08:32 RT : 40003.4 LT : 40000.0
No detector description was entered
NOPI-209 U 3/24/95

ROI # 10-1 RANGE : 59 to 144
AREA : Gross = 3029 Net = 2943 +/- 64
CENTROID : 119.41
SHAPE : Fwhm = 20.16 Channels Fwtm = 63.18 Channels

ROI # 10-2 RANGE : 299 to 391
AREA : Gross = 4580 Net = 4394 +/- 84
CENTROID : 368.21
SHAPE : Fwhm = 28.48 Channels Fwtm = 58.40 Channels

ROI # 10-3 RANGE : 543 to 628
AREA : Gross = 10845 Net = 10228 +/- 136
CENTROID : 604.03
SHAPE : Fwhm = 35.75 Channels Fwtm = 60.99 Channels

NP209Th5.CHW

MCB # 1 ACQ 03-28-95 AT 08:06:33 RT : 60001.8 LT : 60000.0
No detector description was entered
NOPI-209 Th 3/29/95

ROI # 2-1 RANGE : 19 to 93
AREA : Gross = 152 Net = 152 +/- 12
CENTROID : 70.77
SHAPE : Fwhm = 5.65 Channels Fwtm = 26.56 Channels

ROI # 2-2 RANGE : 264 to 359
AREA : Gross = 8765 Net = 8621 +/- 104
CENTROID : 341.12
SHAPE : Fwhm = 21.24 Channels Fwtm = 54.54 Channels

ROI # 2-3 RANGE : 565 to 659
AREA : Gross = 10877 Net = 10260 +/- 139
CENTROID : 637.14
SHAPE : Fwhm = 19.55 Channels Fwtm = 58.87 Channels

ROI # 2-4 RANGE : 674 to 763
AREA : Gross = 6940 Net = 6249 +/- 126
CENTROID : 740.83
SHAPE : Fwhm = 23.76 Channels Fwtm = 59.18 Channels

U and Th Isotope Activities

FILENAME= NP298U5.CHN
NP298TH5.CHN

Sample # **NOPI-298**
Analyst **JDP**

Sep. date **3/20/95**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.2999	0.5056	454.83	1/22/93	787	445.4925

Th-228/U-232= 0.6072609

Counting time for Th= 1000.042 (mins.)
Days btwn. sep. and count.= 9 (days)
CF for Th-228= 0.9907702

Counting time for U= 666.723 (mins.)
Days btwn. sep. and count.= 3 (days)
CF for U-232= 1.0031153

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
252	8312	8808	5730

U-238 counts	U-234 counts	U-232 counts
4062	4475	8491

Bkgd	Bkgd	Bkgd	bkgd
4	7	16	25

bkgd	bkgd	bkgd
0	4	11

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
248	8305	8320.7223	5705

U-238* counts	U-234* counts	U-232sp counts
4062	4471	8453.6646

U-238(dpm/g)= 360.8826 ± 6.884784
U-234(dpm/g)= 397.2196 ± 7.337663

Th-232(dpm/g)= 13.59368 ± 0.868485
Th-230(dpm/g)= 455.2238 ± 6.961221

U-234/U-238= 1.100689 ± 0.023853
Th-230/U-234= 1.146025 ± 0.021249
Th-230/Th-232= 33.4879 ± 2.141279
U234/Th-232= 29.22091 ± 1.94336

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

U(ppb)= 483746.4

Th(ppb)= 55633.8

Spike 25A Spike 25B Spide 25C
10/9/92
Th-228 (dpm/g)= 2708.2115 270.53018 27.038784

WP298US.CHW

MCB # 1 ACQ 03-23-95 AT 16:08:32 RT : 40003.3 LT : 40000.0
No detector description was entered
NOPI-298 U 3/24/95

ROI # 11-1 RANGE : 62 to 162
AREA : Gross = 4233 Net = 4062 +/- 82
CENTROID : 136.03
SHAPE : Fwhm = 34.48 Channels Fwtm = 69.86 Channels

ROI # 11-2 RANGE : 315 to 413
AREA : Gross = 4658 Net = 4475 +/- 86
CENTROID : 386.44
SHAPE : Fwhm = 34.75 Channels Fwtm = 70.86 Channels

ROI # 11-3 RANGE : 569 to 649
AREA : Gross = 9611 Net = 8491 +/- 150
CENTROID : 622.76
SHAPE : Fwhm = 41.45 Channels Fwtm = 65.13 Channels

NP298Th5.cHW

MCB # 1 ACQ 03-29-95 AT 08:38:36 RT : 60002.5 LT : 60000.0
No detector description was entered
NOPI-298 Th 3/30/95

ROI # 1-1 RANGE : 21 to 87
AREA : Gross = 319 Net = 252 +/- 31
CENTROID : 74.74
SHAPE : Fwhm = 3.10 Channels Fwtm = 17.47 Channels

ROI # 1-2 RANGE : 243 to 352
AREA : Gross = 8445 Net = 8312 +/- 103
CENTROID : 334.71
SHAPE : Fwhm = 19.35 Channels Fwtm = 60.01 Channels

ROI # 1-3 RANGE : 533 to 649
AREA : Gross = 9765 Net = 8808 +/- 163
CENTROID : 630.70
SHAPE : Fwhm = 20.42 Channels Fwtm = 60.16 Channels

ROI # 1-4 RANGE : 665 to 756
AREA : Gross = 6571 Net = 5730 +/- 133
CENTROID : 734.91
SHAPE : Fwhm = 24.77 Channels Fwtm = 56.88 Channels

U and Th Isotope Activities

FILENAME= NP302U5.CHN
NP302TH5.CHN

Sample # **NOPI-302**
Analyst **JDP**

Sep. date **3/20/95**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.4394	0.5045	454.83	1/22/93	787	445.4925

Th-228/U-232= **0.6072609**

Counting time for Th= **1000.042** (mins.)
Days btwn. sep. and count.= **9** (days)
CF for Th-228= **0.9907702**

Counting time for U= **2000.073** (mins.)
Days btwn. sep. and count.= **3** (days)
CF for U-232= **1.0035606**

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
825	45434	9511	6372

U-238 counts	U-234 counts	U-232 counts
716	1036	389

Bkgd	Bkgd	Bkgd	bkgd
2	3	12	22

bkgd	bkgd	bkgd
17	19	22

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
823	45431	8424.8051	6350

U-238* counts	U-234* counts	U-232sp counts
699	1017	365.69788

U-238(dpm/g)= **977.6789** ± **61.58091**
U-234(dpm/g)= **1422.46** ± **84.58489**

Th-232(dpm/g)= **30.34288** ± **1.101268**
Th-230(dpm/g)= **1674.979** ± **18.8873**

U-234/U-238= **1.454936** ± **0.070709**
Th-230/U-234= **1.177523** ± **0.036999**
Th-230/Th-232= **55.2017** ± **1.939247**
U234/Th-232= **46.87953** ± **3.265861**

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

U(ppb)= **1310533**

Th(ppb)= **124182**

Spike 25A Spike 25B Spide 25C
10/9/92
Th-228 (dpm/g)= 2708.2115 270.53018 27.038784

NP30ZUS.CHW

MCB # 1 ACQ 03-23-95 AT 16:08:32 RT : 120004.4 LT : 120000.0
No detector description was entered
NOPI-302 U 3/27/95

ROI # 12-1 RANGE : 96 to 157
AREA : Gross = 809 Net = 716 +/- 40
CENTROID : 135.04
SHAPE : Fwhm = 20.39 Channels Fwtm = 44.94 Channels

ROI # 12-2 RANGE : 333 to 410
AREA : Gross = 1114 Net = 1036 +/- 44
CENTROID : 385.87
SHAPE : Fwhm = 16.36 Channels Fwtm = 47.65 Channels

ROI # 12-3 RANGE : 578 to 643
AREA : Gross = 442 Net = 389 +/- 30
CENTROID : 627.41
SHAPE : Fwhm = 2.55 Channels Fwtm = 46.08 Channels

NP 302 Th 5. CHW

MCB # 1 ACQ 03-29-95 AT 08:38:36 RT : 60002.5 LT : 60000.0
No detector description was entered
NOPI-302 Th 3/30/95

ROI # 2-1 RANGE : 21 to 91
AREA : Gross = 861 Net = 825 +/- 35
CENTROID : 73.35
SHAPE : Fwhm = 9.14 Channels Fwtm = 49.38 Channels

ROI # 2-2 RANGE : 233 to 361
AREA : Gross = 45716 Net = 45434 +/- 226
CENTROID : 340.33
SHAPE : Fwhm = 24.06 Channels Fwtm = 58.92 Channels

ROI # 2-3 RANGE : 555 to 658
AREA : Gross = 10168 Net = 9511 +/- 142
CENTROID : 637.09
SHAPE : Fwhm = 20.25 Channels Fwtm = 57.67 Channels

ROI # 2-4 RANGE : 681 to 768
AREA : Gross = 7488 Net = 6372 +/- 147
CENTROID : 742.63
SHAPE : Fwhm = 23.37 Channels Fwtm = 55.92 Channels

U and Th Isotope Activities

FILENAME= NP372U.CHN
NP372TH.CHNSample # NOPI-372
Analyst JDP

Sep. date 2/23/95

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.4962	1.0018	454.83	1/22/93	762	445.78616

Th-228/U-232= 0.5960073

Counting time for Th= 1000.09 (mins.)
 Days btwn. sep. and count.= 5 (days)
 CF for Th-228= 0.9947095

Counting time for U= 833.412 (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
378	8080	20707	5185

Bkgd	Bkgd	Bkgd	bkgd
4	7	14	26

U-238 counts	U-234 counts	U-232 counts
5420	5995	32130

bkgd	bkgd	bkgd
9	8	6

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
374	8073	20154.178	5159

U-238* counts	U-234* counts	U-232sp counts
5411	5987	31991.784

U-238(dpm/g)= 152.22638 ± 2.235321
 U-234(dpm/g)= 168.43085 ± 2.369609

Th-232(dpm/g)= 9.9542587 ± 0.516644
 Th-230(dpm/g)= 214.86826 ± 2.818423

U-234/U-238= 1.1064498 ± 0.020738
 Th-230/U-234= 1.2757061 ± 0.021746
 Th-230/Th-232= 21.585561 ± 1.135914
 U234/Th-232= 16.920482 ± 0.909895

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

U(ppb)= 204052.4

Th(ppb)= 40739.027

Spike 25A Spike 25B Spide 25C
 10/9/92
 Th-228 (dpm/g)= 2659.7755 265.69179 26.555199

NP372U.CHW

MCB # 1 ACQ 02-27-95 AT 15:02:24 RT : 50004.7 LT : 50000.0
No detector description was entered
NOPI-372 U 2/28/95

ROI # 1-1 RANGE : 69 to 162
AREA : Gross = 5514 Net = 5420 +/- 82
CENTROID : 144.31
SHAPE : Fwhm = 17.60 Channels Fwtm = 49.91 Channels

ROI # 1-2 RANGE : 292 to 392
AREA : Gross = 6075 Net = 5995 +/- 85
CENTROID : 372.92
SHAPE : Fwhm = 18.21 Channels Fwtm = 53.43 Channels

ROI # 1-3 RANGE : 532 to 611
AREA : Gross = 33559 Net = 32130 +/- 223
CENTROID : 590.72
SHAPE : Fwhm = 17.23 Channels Fwtm = 50.05 Channels

NP372Th.CHW

MCB # 1 ACQ 02-28-95 AT 11:01:29 RT : 60005.5 LT : 60000.0
No detector description was entered
NOPI-372 Th 3/1/95

ROI # 1-1 RANGE : 31 to 88
AREA : Gross = 435 Net = 378 +/- 30
CENTROID : 68.22
SHAPE : Fwhm = 10.73 Channels Fwtm = 34.18 Channels

ROI # 1-2 RANGE : 261 to 354
AREA : Gross = 8151 Net = 8080 +/- 96
CENTROID : 336.33
SHAPE : Fwhm = 18.20 Channels Fwtm = 49.44 Channels

ROI # 1-3 RANGE : 565 to 656
AREA : Gross = 21107 Net = 20707 +/- 163
CENTROID : 632.71
SHAPE : Fwhm = 16.17 Channels Fwtm = 55.64 Channels

ROI # 1-4 RANGE : 676 to 761
AREA : Gross = 5572 Net = 5185 +/- 102
CENTROID : 731.69
SHAPE : Fwhm = 31.16 Channels Fwtm = 54.17 Channels

U and Th Isotope Activities

FILENAME= NP373U.CHN
NP373TH.CHN

Sample # **NOPI-373**
Analyst **JDP**

Sep. date **2/23/95**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.5068	1.0021	454.83	1/22/93	762	445.78616

Th-228/U-232= **0.5960073**

Counting time for Th= **1000.09** (mins.)
Days btwn. sep. and count.= **5** (days)
CF for Th-228= **0.9947095**

Counting time for U= **833.412** (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
462	11003	18594	4702

U-238 counts	U-234 counts	U-232 counts
7040	7611	24327

Bkgd	Bkgd	Bkgd	bkgd
2	3	12	18

bkgd	bkgd	bkgd
2	5	5

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
460	11000	17971.259	4684

U-238* counts	U-234* counts	U-232sp counts
7038	7606	24221.896

U-238(dpm/g)= **256.11922** ± **3.466156**
U-234(dpm/g)= **276.78926** ± **3.635281**

Th-232(dpm/g)= **13.447202** ± **0.633345**
Th-230(dpm/g)= **321.56352** ± **3.867663**

U-234/U-238= **1.0807047** ± **0.01787**
Th-230/U-234= **1.161763** ± **0.017321**
Th-230/Th-232= **23.913043** ± **1.135652**
U234/Th-232= **20.583409** ± **1.006438**

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

U(ppb)= **343315.93**

Th(ppb)= **55034.326**

Spike 25A Spike 25B Spide 25C
10/9/92
Th-228 (dpm/g)= 2659.7755 265.69179 26.555199

NP373U-CHW

MCB # 1 ACQ 02-27-95 AT 15:02:24 RT : 50004.7 LT : 50000.0
No detector description was entered
NOPI-373 U 2/28/95

ROI # 2-1 RANGE : 63 to 170
AREA : Gross = 7188 Net = 7040 +/- 98
CENTROID : 147.78
SHAPE : Fwhm = 30.87 Channels Fwtm = 64.36 Channels

ROI # 2-2 RANGE : 292 to 398
AREA : Gross = 7805 Net = 7611 +/- 104
CENTROID : 377.97
SHAPE : Fwhm = 35.27 Channels Fwtm = 64.89 Channels

ROI # 2-3 RANGE : 536 to 617
AREA : Gross = 26200 Net = 24327 +/- 219
CENTROID : 603.40
SHAPE : Fwhm = 35.31 Channels Fwtm = 57.40 Channels

NP373Th.CHW

MCB # 1 ACQ 02-28-95 AT 11:01:29 RT : 60005.5 LT : 60000.0
No detector description was entered
NOPI-373 Th 3/1/95

ROI # 2-1 RANGE : 32 to 91
AREA : Gross = 477 Net = 462 +/- 24
CENTROID : 75.73
SHAPE : Fwhm = 15.21 Channels Fwtm = 33.74 Channels

ROI # 2-2 RANGE : 280 to 362
AREA : Gross = 11086 Net = 11003 +/- 110
CENTROID : 343.23
SHAPE : Fwhm = 16.45 Channels Fwtm = 49.65 Channels

ROI # 2-3 RANGE : 566 to 667
AREA : Gross = 18797 Net = 18594 +/- 148
CENTROID : 639.05
SHAPE : Fwhm = 15.14 Channels Fwtm = 54.49 Channels

ROI # 2-4 RANGE : 684 to 762
AREA : Gross = 4991 Net = 4702 +/- 91
CENTROID : 739.94
SHAPE : Fwhm = 25.53 Channels Fwtm = 48.73 Channels

U and Th Isotope Activities

FILENAME= NP374U.CHN
NP374TH.CHN

Sample # **NOPI-374**
Analyst **JDP**

Sep. date **2/23/95**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.512	0.4995	454.83	1/22/93	762	445.78616

Th-228/U-232= **0.5960073**

Counting time for Th= **471.907** (mins.)
Days btwn. sep. and count.= **6** (days)
CF for Th-228= **0.993904**

Counting time for U= **833.412** (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
127	2679	4573	1544
Bkgd	Bkgd	Bkgd	bkgd
2	4	7	12

U-238 counts	U-234 counts	U-232 counts
3071	2875	10015
bkgd	bkgd	bkgd
6	9	8

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
125	2675	4387.3111	1532

U-238* counts	U-234* counts	U-232sp counts
3065	2866	9965.8133

U-238(dpm/g)= **133.75494** ± **2.758976**
U-234(dpm/g)= **125.07069** ± **2.646291**

Th-232(dpm/g)= **7.3850808** ± **0.664357**
Th-230(dpm/g)= **158.04073** ± **3.845129**

U-234/U-238= **0.9350734** ± **0.024266**
Th-230/U-234= **1.2636112** ± **0.033932**
Th-230/Th-232= **21.4** ± **1.943432**
U234/Th-232= **16.935589** ± **1.565087**

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

U(ppb)= **179292.3**

Th(ppb)= **30224.351**

Spike 25A Spike 25B Spide 25C
10/9/92
Th-228 (dpm/g)= 2659.7755 265.69179 26.555199

NP374U.CHW

MCB # 1 ACQ 02-27-95 AT 15:02:25 RT : 50004.7 LT : 50000.0
No detector description was entered
NOPI-374 U 2/28/95

ROI # 7-1 RANGE : 77 to 153
AREA : Gross = 3148 Net = 3071 +/- 63
CENTROID : 127.50
SHAPE : Fwhm = 22.36 Channels Fwtm = 50.63 Channels

ROI # 7-2 RANGE : 319 to 401
AREA : Gross = 2987 Net = 2875 +/- 66
CENTROID : 376.18
SHAPE : Fwhm = 25.10 Channels Fwtm = 47.89 Channels

ROI # 7-3 RANGE : 555 to 641
AREA : Gross = 10392 Net = 10015 +/- 123
CENTROID : 612.66
SHAPE : Fwhm = 22.27 Channels Fwtm = 52.36 Channels

NP374Th.CHN

MCB # 1 ACQ 03-01-95 AT 08:20:04 RT : 28314.4 LT : 28313.3
No detector description was entered
NOPI-374 Th 3/1/95

ROI # 1-1 RANGE : 31 to 84
AREA : Gross = 127 Net = 127 +/- 11
CENTROID : 74.00
SHAPE : Fwhm = 3.00 Channels Fwtm = 11.88 Channels

ROI # 1-2 RANGE : 272 to 353
AREA : Gross = 2699 Net = 2679 +/- 54
CENTROID : 337.04
SHAPE : Fwhm = 13.70 Channels Fwtm = 47.91 Channels

ROI # 1-3 RANGE : 568 to 654
AREA : Gross = 4729 Net = 4573 +/- 82
CENTROID : 633.43
SHAPE : Fwhm = 14.89 Channels Fwtm = 34.99 Channels

ROI # 1-4 RANGE : 696 to 758
AREA : Gross = 1638 Net = 1544 +/- 49
CENTROID : 736.54
SHAPE : Fwhm = 21.00 Channels Fwtm = 41.98 Channels

U and Th Isotope Activities

FILENAME= NP375U.CHN
NP375TH.CHN

Sample # **NOPI-375**
Analyst **JDP**

Sep. date **2/23/95**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)	Th-228/U-232=
0.5113	0.9868	454.83	1/22/93	762	445.78616	0.5960073

Counting time for Th=	473.317	(mins.)	Counting time for U=	500.05	(mins.)
Days btwn. sep. and count.=	6	(days)	Days btwn. sep. and count.=	4	(days)
CF for Th-228=	0.9939035		CF for U-232=	1.0040215	

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
144	10063	7454	2626

U-238 counts	U-234 counts	U-232 counts
4943	5369	7269

Bkgd	Bkgd	Bkgd	bkgd
1	2	6	9

bkgd	bkgd	bkgd
5	7	8

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
143	10061	7211.1334	2617

U-238* counts	U-234* counts	U-232sp counts
4938	5362	7231.9166

U-238(dpm/g)= 587.45906 ± 10.83025
U-234(dpm/g)= 637.90107 ± 11.47912

Th-232(dpm/g)= 10.168666 ± 0.855535
Th-230(dpm/g)= 715.43323 ± 10.93303

U-234/U-238= 1.0858647 ± 0.021405
Th-230/U-234= 1.1215426 ± 0.018955
Th-230/Th-232= 70.356643 ± 5.904854
U234/Th-232= 62.732029 ± 5.397298

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

U(ppb)= 787461.61

Th(ppb)= 41616.516

	Spike 25A	Spike 25B	Spide 25C
	10/9/92		
Th-228 (dpm/g)=	2659.7755	265.69179	26.555199

NP375U-LHW

MCB # 1 ACQ 02-27-95 AT 15:02:25 RT : 30003.0 LT : 30000.0
No detector description was entered
NOPI-375 U 2/28/95

ROI # 8-1 RANGE : 25 to 149
AREA : Gross = 5381 Net = 4943 +/- 117
CENTROID : 115.60
SHAPE : Fwhm = 56.68 Channels Fwtm = 92.07 Channels

ROI # 8-2 RANGE : 262 to 400
AREA : Gross = 5619 Net = 5369 +/- 104
CENTROID : 363.20
SHAPE : Fwhm = 57.90 Channels Fwtm = 100.52 Channels

ROI # 8-3 RANGE : 537 to 641
AREA : Gross = 8494 Net = 7269 +/- 166
CENTROID : 599.11
SHAPE : Fwhm = 53.09 Channels Fwtm = 82.37 Channels

NP375Th.ctw

MCB # 1 ACQ 03-01-95 AT 08:20:04 RT : 28405.9 LT : 28404.8
No detector description was entered
NOPI-375 Th 3/1/95

ROI # 2-1 RANGE : 33 to 92
AREA : Gross = 144 Net = 144 +/- 12
CENTROID : 78.00
SHAPE : Fwhm = 1.83 Channels Fwtm = 13.96 Channels

ROI # 2-2 RANGE : 265 to 362
AREA : Gross = 10112 Net = 10063 +/- 104
CENTROID : 342.93
SHAPE : Fwhm = 17.96 Channels Fwtm = 49.19 Channels

ROI # 2-3 RANGE : 567 to 657
AREA : Gross = 7636 Net = 7454 +/- 100
CENTROID : 639.30
SHAPE : Fwhm = 15.46 Channels Fwtm = 55.60 Channels

ROI # 2-4 RANGE : 687 to 762
AREA : Gross = 2892 Net = 2626 +/- 76
CENTROID : 742.25
SHAPE : Fwhm = 21.73 Channels Fwtm = 40.60 Channels

U and Th Isotope Activities

FILENAME= NP376U.CHN
NP376TH.CHN

Sample # **NOPI-376**
Analyst **JDP**

Sep. date **2/23/95**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.5068	0.9862	454.83	1/22/93	762	445.78616

Th-228/U-232= **0.5960073**

Counting time for Th= **911.505** (mins.)
Days btwn. sep. and count.= **6** (days)
CF for Th-228= **0.9937535**

Counting time for U= **833.412** (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
231	8585	15224	6055

U-238 counts	U-234 counts	U-232 counts
1806	1942	8255

Bkgd	Bkgd	Bkgd	bkgd
3	5	13	24

bkgd	bkgd	bkgd
1	3	9

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
228	8580	14756.96	6031

U-238* counts	U-234* counts	U-232sp counts
1805	1939	8212.0612

U-238(dpm/g)= **190.66896** ± **4.953169**
U-234(dpm/g)= **204.82389** ± **5.165753**

Th-232(dpm/g)= **7.9881179** ± **0.529552**
Th-230(dpm/g)= **300.60549** ± **4.057261**

U-234/U-238= **1.0742382** ± **0.035117**
Th-230/U-234= **1.4676291** ± **0.036879**
Th-230/Th-232= **37.631579** ± **2.509066**
U234/Th-232= **25.64107** ± **1.818666**

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

U(ppb)= **255582.9**

Th(ppb)= **32692.354**

Spike 25A Spike 25B Spide 25C
10/9/92
Th-228 (dpm/g)= 2659.7755 265.69179 26.555199

MCB # 1 ACQ 02-27-95 AT 15:02:25 RT : 50004.7 LT : 50000.0
No detector description was entered
NOPI-376 U 2/28/95

ROI # 9-1 RANGE : 65 to 158
AREA : Gross = 1900 Net = 1806 +/- 56
CENTROID : 130.91
SHAPE : Fwhm = 41.26 Channels Fwtm = 70.40 Channels

ROI # 9-2 RANGE : 311 to 405
AREA : Gross = 2084 Net = 1942 +/- 64
CENTROID : 379.54
SHAPE : Fwhm = 20.43 Channels Fwtm = 72.74 Channels

ROI # 9-3 RANGE : 540 to 645
AREA : Gross = 8749 Net = 8255 +/- 128
CENTROID : 608.94
SHAPE : Fwhm = 46.91 Channels Fwtm = 75.79 Channels

NP376 Th. CHW

MCB # 1 ACQ 03-01-95 AT 16:32:19 RT : 54690.3 LT : 54687.0
No detector description was entered
NOPI-376 Th 3/2/95

ROI # 1-1 RANGE : 31 to 87
AREA : Gross = 280 Net = 231 +/- 25
CENTROID : 72.93
SHAPE : Fwhm = 5.05 Channels Fwtm = 27.58 Channels

ROI # 1-2 RANGE : 252 to 353
AREA : Gross = 8687 Net = 8585 +/- 101
CENTROID : 336.44
SHAPE : Fwhm = 17.73 Channels Fwtm = 49.16 Channels

ROI # 1-3 RANGE : 559 to 656
AREA : Gross = 15812 Net = 15224 +/- 156
CENTROID : 632.95
SHAPE : Fwhm = 16.44 Channels Fwtm = 55.80 Channels

ROI # 1-4 RANGE : 685 to 758
AREA : Gross = 6436 Net = 6055 +/- 102
CENTROID : 737.16
SHAPE : Fwhm = 21.59 Channels Fwtm = 46.09 Channels

U and Th Isotope Activities

FILENAME= NP377U.CHN
NP377TH.CHNSample # NOPI-377
Analyst JDP

Sep. date 2/23/95

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.5159	0.9844	454.83	1/22/93	762	445.78616

Th-228/U-232= 0.5960073

Counting time for Th= 912.475 (mins.)
 Days btwn. sep. and count.= 6 (days)
 CF for Th-228= 0.9937532

Counting time for U= 833.412 (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
368	9103	17860	6990

U-238 counts	U-234 counts	U-232 counts
4458	5603	23413

Bkgd	Bkgd	Bkgd	bkgd
1	3	10	17

bkgd	bkgd	bkgd
1	1	9

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
367	9100	17223.314	6973

U-238* counts	U-234* counts	U-232sp counts
4457	5602	23307.674

U-238(dpm/g)= 162.65835 ± 2.657994
 U-234(dpm/g)= 204.44516 ± 3.040582

Th-232(dpm/g)= 10.802731 ± 0.568903
 Th-230(dpm/g)= 267.86063 ± 3.44953

U-234/U-238= 1.2568993 ± 0.025226
 Th-230/U-234= 1.3101833 ± 0.022247
 Th-230/Th-232= 24.79564 ± 1.31843
 U234/Th-232= 18.925322 ± 1.035644

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

U(ppb)= 218035.97

Th(ppb)= 44211.503

Spike 25A Spike 25B Spide 25C
 10/9/92
 Th-228 (dpm/g)= 2659.7755 265.69179 26.555199

NP377U.CHW

MCB # 1 ACQ 02-27-95 AT 15:02:26 RT : 50004.7 LT : 50000.0
No detector description was entered
NOPI-377 U 2/28/95

ROI # 10-1 RANGE : 52 to 146
AREA : Gross = 4534 Net = 4458 +/- 75
CENTROID : 117.09
SHAPE : Fwhm = 33.96 Channels Fwtm = 59.54 Channels

ROI # 10-2 RANGE : 295 to 392
AREA : Gross = 5750 Net = 5603 +/- 89
CENTROID : 365.42
SHAPE : Fwhm = 35.89 Channels Fwtm = 58.79 Channels

ROI # 10-3 RANGE : 532 to 631
AREA : Gross = 23980 Net = 23413 +/- 180
CENTROID : 601.84
SHAPE : Fwhm = 39.06 Channels Fwtm = 62.67 Channels

MCB # 1 ACQ 03-01-95 AT 16:32:19 RT : 54748.5 LT : 54745.3
No detector description was entered
NOPI-377 Th 3/2/95

ROI # 2-1 RANGE : 29 to 95
AREA : Gross = 368 Net = 368 +/- 19
CENTROID : 77.34
SHAPE : Fwhm = 13.69 Channels Fwtm = 45.52 Channels

ROI # 2-2 RANGE : 270 to 363
AREA : Gross = 9225 Net = 9103 +/- 104
CENTROID : 343.00
SHAPE : Fwhm = 17.84 Channels Fwtm = 52.60 Channels

ROI # 2-3 RANGE : 567 to 661
AREA : Gross = 18430 Net = 17860 +/- 162
CENTROID : 639.45
SHAPE : Fwhm = 16.72 Channels Fwtm = 56.35 Channels

ROI # 2-4 RANGE : 686 to 766
AREA : Gross = 7597 Net = 6990 +/- 121
CENTROID : 741.92
SHAPE : Fwhm = 27.27 Channels Fwtm = 50.92 Channels

U and Th Isotope Activities

FILENAME= NP378U.CHN
NP378TH.CHNSample # NOPI-378
Analyst JDP

Sep. date 2/23/95

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.5059	0.5004	454.83	1/22/93	762	445.78616

Th-228/U-232= 0.5960073

Counting time for Th= 457.13 (mins.)
 Days btwn. sep. and count.= 7 (days)
 CF for Th-228= 0.9929236

Counting time for U= 833.412 (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
160	4449	5170	2452

U-238 counts	U-234 counts	U-232 counts
5249	5486	10481

Bkgd	Bkgd	Bkgd	bkgd
2	3	7	11

bkgd	bkgd	bkgd
1	4	14

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
158	4446	4911.501	2441

U-238* counts	U-234* counts	U-232sp counts
5248	5482	10423.92

U-238(dpm/g)= 221.99437 ± 3.753761
 U-234(dpm/g)= 231.89275 ± 3.864289

Th-232(dpm/g)= 8.4542212 ± 0.678628
 Th-230(dpm/g)= 237.89537 ± 4.864906

U-234/U-238= 1.0445884 ± 0.020169
 Th-230/U-234= 1.0258853 ± 0.020698
 Th-230/Th-232= 28.139241 ± 2.264251
 U234/Th-232= 27.429226 ± 2.248714

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

U(ppb)= 297573.15

Th(ppb)= 34599.939

Spike 25A Spike 25B Spide 25C
 10/9/92
 Th-228 (dpm/g)= 2659.7755 265.69179 26.555199

MCB # 1 ACQ 02-27-95 AT 15:02:26 RT : 50004.7 LT : 50000.0
No detector description was entered
NOPI-378 U 2/28/95

ROI # 11-1 RANGE : 61 to 163
AREA : Gross = 5456 Net = 5249 +/- 93
CENTROID : 133.12
SHAPE : Fwhm = 41.27 Channels Fwtm = 72.85 Channels

ROI # 11-2 RANGE : 317 to 416
AREA : Gross = 5770 Net = 5486 +/- 100
CENTROID : 380.76
SHAPE : Fwhm = 41.04 Channels Fwtm = 71.32 Channels

ROI # 11-3 RANGE : 561 to 651
AREA : Gross = 11556 Net = 10481 +/- 160
CENTROID : 618.95
SHAPE : Fwhm = 40.20 Channels Fwtm = 65.82 Channels

NP 378th. CHW

MCB # 1 ACQ 03-02-95 AT 07:56:40 RT : 27427.8 LT : 27427.0
No detector description was entered
NOPI-378 Th 3/2/95

ROI # 1-1 RANGE : 25 to 86
AREA : Gross = 160 Net = 160 +/- 13
CENTROID : 74.38
SHAPE : Fwhm = 2.34 Channels Fwtm = 16.92 Channels

ROI # 1-2 RANGE : 269 to 355
AREA : Gross = 4471 Net = 4449 +/- 69
CENTROID : 336.55
SHAPE : Fwhm = 16.31 Channels Fwtm = 48.97 Channels

ROI # 1-3 RANGE : 567 to 647
AREA : Gross = 5468 Net = 5170 +/- 94
CENTROID : 632.96
SHAPE : Fwhm = 14.76 Channels Fwtm = 31.02 Channels

ROI # 1-4 RANGE : 689 to 757
AREA : Gross = 2659 Net = 2452 +/- 68
CENTROID : 736.65
SHAPE : Fwhm = 18.46 Channels Fwtm = 36.79 Channels

U and Th Isotope Activities

FILENAME= NP379U.CHN
NP379TH.CHNSample # **NOPI-379**
Analyst **JDP**Sep. date **2/23/95**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.5017	0.498	454.83	1/22/93	762	445.78616

Th-228/U-232= **0.5960073**

Counting time for Th= **913.735** (mins.)
 Days btwn. sep. and count.= **6** (days)
 CF for Th-228= **0.9937528**

Counting time for U= **833.412** (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
213	5568	7493	3261

U-238 counts	U-234 counts	U-232 counts
2614	3079	7249

Bkgd	Bkgd	Bkgd	bkgd
5	12	26	97

bkgd	bkgd	bkgd
8	8	9

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
208	5556	7137.1952	3164

U-238* counts	U-234* counts	U-232sp counts
2606	3071	7210.2017

U-238(dpm/g)= **159.93327** ± **3.648812**
 U-234(dpm/g)= **188.47087** ± **4.054231**

Th-232(dpm/g)= **7.685978** ± **0.534067**
 Th-230(dpm/g)= **205.3043** ± **3.632526**

U-234/U-238= **1.1784344** ± **0.031341**
 Th-230/U-234= **1.0893158** ± **0.024464**
 Th-230/Th-232= **26.711538** ± **1.864923**
 U234/Th-232= **24.52139** ± **1.783672**

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

U(ppb)= **214383.13**Th(ppb)= **31455.81**

Spike 25A Spike 25B Spide 25C
 10/9/92
 Th-228 (dpm/g)= 2659.7755 265.69179 26.555199

NP379U.CHW

MCB # 1 ACQ 02-27-95 AT 15:02:26 RT : 50004.7 LT : 50000.0
No detector description was entered
NOPI-379 U 2/28/95

ROI # 12-1 RANGE : 80 to 155
AREA : Gross = 2861 Net = 2614 +/- 74
CENTROID : 133.87
SHAPE : Fwhm = 24.44 Channels Fwtm = 51.06 Channels

ROI # 12-2 RANGE : 333 to 410
AREA : Gross = 3220 Net = 3079 +/- 69
CENTROID : 384.77
SHAPE : Fwhm = 21.35 Channels Fwtm = 54.21 Channels

ROI # 12-3 RANGE : 573 to 648
AREA : Gross = 7870 Net = 7249 +/- 120
CENTROID : 621.36
SHAPE : Fwhm = 23.84 Channels Fwtm = 52.93 Channels

NP379Th.cfw

MCB # 1 ACQ 03-01-95 AT 16:32:20 RT : 54824.1 LT : 54820.9
No detector description was entered
NOPI-379 Th 3/2/95

ROI # 6-1 RANGE : 18 to 78
AREA : Gross = 252 Net = 213 +/- 24
CENTROID : 58.69
SHAPE : Fwhm = 6.81 Channels Fwtm = 28.51 Channels

ROI # 6-2 RANGE : 241 to 335
AREA : Gross = 5662 Net = 5568 +/- 83
CENTROID : 312.92
SHAPE : Fwhm = 19.34 Channels Fwtm = 53.61 Channels

ROI # 6-3 RANGE : 526 to 614
AREA : Gross = 7862 Net = 7493 +/- 112
CENTROID : 592.88
SHAPE : Fwhm = 16.93 Channels Fwtm = 55.48 Channels

ROI # 6-4 RANGE : 634 to 713
AREA : Gross = 3370 Net = 3261 +/- 68
CENTROID : 689.16
SHAPE : Fwhm = 21.41 Channels Fwtm = 50.36 Channels

U and Th Isotope Activities

FILENAME= NP380U.CHN
NP380TH.CHN

Sample # **NOPI-380**
Analyst **JDP**

Sep. date **3/28/95**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.509	0.4964	454.83	1/22/93	795	445.3986

Th-228/U-232= **0.6108101**

Counting time for Th= **1404.733** (mins.)
Days btwn. sep. and count.= **9** (days)
CF for Th-228= **0.9906322**

Counting time for U= **940.72** (mins.)
Days btwn. sep. and count.= **6** (days)
CF for U-232= **1.0060892**

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
462	7298	14204	6271

U-238 counts	U-234 counts	U-232 counts
3643	3450	12706

Bkgd	Bkgd	Bkgd	bkgd
7	10	23	36

bkgd	bkgd	bkgd
0	5	16

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
455	7288	13526.522	6235

U-238* counts	U-234* counts	U-232sp counts
3643	3445	12613.196

U-238(dpm/g)= **125.4576** ± **2.357808**
U-234(dpm/g)= **118.6388** ± **2.277613**

Th-232(dpm/g)= **8.924714** ± **0.421914**
Th-230(dpm/g)= **142.9523** ± **2.058844**

U-234/U-238= **0.945649** ± **0.022465**
Th-230/U-234= **1.204937** ± **0.024895**
Th-230/Th-232= **16.01758** ± **0.768431**
U234/Th-232= **13.29329** ± **0.678279**

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

U(ppb)= **168170.1**

Th(ppb)= **36525.49**

Spike 25A Spike 25B Spide 25C
10/9/92
Th-228 (dpm/g)= 2723.4657 272.05397 27.191082

NP380U.CHW

MCB # 1 ACQ 04-03-95 AT 14:58:45 RT : 56443.4 LT : 56436.5
No detector description was entered
NOPI-380 U 4/4/95

ROI # 11-1 RANGE : 65 to 165
AREA : Gross = 3796 Net = 3643 +/- 78
CENTROID : 137.65
SHAPE : Fwhm = 32.09 Channels Fwtm = 51.56 Channels

ROI # 11-2 RANGE : 326 to 408
AREA : Gross = 3699 Net = 3450 +/- 82
CENTROID : 388.61
SHAPE : Fwhm = 23.01 Channels Fwtm = 54.68 Channels

ROI # 11-3 RANGE : 561 to 649
AREA : Gross = 13551 Net = 12706 +/- 156
CENTROID : 624.96
SHAPE : Fwhm = 27.35 Channels Fwtm = 59.91 Channels

NP380Th.cHW

MCB # 1 ACQ 04-05-95 AT 07:26:58 RT : 84284.0 LT : 84281.2
No detector description was entered
NOPI-380 Th 4/6/95

ROI # 1-1 RANGE : 20 to 86
AREA : Gross = 512 Net = 462 +/- 31
CENTROID : 64.94
SHAPE : Fwhm = 1.62 Channels Fwtm = 39.98 Channels

ROI # 1-2 RANGE : 242 to 353
AREA : Gross = 7392 Net = 7298 +/- 95
CENTROID : 333.08
SHAPE : Fwhm = 30.49 Channels Fwtm = 59.43 Channels

ROI # 1-3 RANGE : 533 to 652
AREA : Gross = 15063 Net = 14204 +/- 175
CENTROID : 630.11
SHAPE : Fwhm = 19.52 Channels Fwtm = 62.51 Channels

ROI # 1-4 RANGE : 662 to 755
AREA : Gross = 7008 Net = 6271 +/- 131
CENTROID : 730.34
SHAPE : Fwhm = 36.38 Channels Fwtm = 71.15 Channels

U and Th Isotope Activities

FILENAME= NP381U.CHN
NP381TH.CHN

Sample # **NOPI-381**
Analyst **JDP**

Sep. date **3/28/95**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.506	0.499	454.83	1/22/93	795	445.3986

Th-228/U-232= **0.6108101**

Counting time for Th= **1405.32** (mins.)
Days btwn. sep. and count.= **9** (days)
CF for Th-228= **0.990632**

Counting time for U= **940.72** (mins.)
Days btwn. sep. and count.= **6** (days)
CF for U-232= **1.0060892**

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
433	46535	14142	6537

U-238 counts	U-234 counts	U-232 counts
5741	6680	3392

Bkgd	Bkgd	Bkgd	bkgd
3	6	15	26

bkgd	bkgd	bkgd
15	13	12

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
430	46529	13482.248	6511

U-238* counts	U-234* counts	U-232sp counts
5726	6667	3359.543

U-238(dpm/g)= **748.6348** ± **16.21269**
U-234(dpm/g)= **871.664** ± **18.37769**

Th-232(dpm/g)= **8.556797** ± **0.417461**
Th-230(dpm/g)= **925.9052** ± **8.890645**

U-234/U-238= **1.164338** ± **0.020954**
Th-230/U-234= **1.062227** ± **0.013898**
Th-230/Th-232= **108.207** ± **5.224232**
U234/Th-232= **101.868** ± **5.414064**

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

U(ppb)= **1003510**

Th(ppb)= **35019.74**

Spike 25A Spike 25B Spide 25C
10/9/92
Th-228 (dpm/g)= 2723.4657 272.05397 27.191082

NP3814.CHN

MCB # 1 ACQ 04-03-95 AT 14:58:46 RT : 56443.2 LT : 56436.3
No detector description was entered
NOPI-381 U 4/4/95

ROI # 12-1 RANGE : 53 to 156
AREA : Gross = 6401 Net = 5741 +/- 129
CENTROID : 131.36
SHAPE : Fwhm = 37.97 Channels Fwtm = 69.51 Channels

ROI # 12-2 RANGE : 294 to 405
AREA : Gross = 7166 Net = 6680 +/- 124
CENTROID : 375.80
SHAPE : Fwhm = 39.18 Channels Fwtm = 77.70 Channels

ROI # 12-3 RANGE : 559 to 646
AREA : Gross = 4008 Net = 3392 +/- 109
CENTROID : 613.30
SHAPE : Fwhm = 42.84 Channels Fwtm = 65.04 Channels

NP381Th-CHW

MCB # 1 ACQ 04-05-95 AT 07:26:58 RT : 84319.0 LT : 84316.2
No detector description was entered
NOPI-381 Th 4/6/95

ROI # 2-1 RANGE : 21 to 96
AREA : Gross = 507 Net = 433 +/- 36
CENTROID : 71.04
SHAPE : Fwhm = 11.05 Channels Fwtm = 33.69 Channels

ROI # 2-2 RANGE : 230 to 363
AREA : Gross = 46648 Net = 46535 +/- 221
CENTROID : 340.96
SHAPE : Fwhm = 20.72 Channels Fwtm = 55.42 Channels

ROI # 2-3 RANGE : 547 to 656
AREA : Gross = 14857 Net = 14142 +/- 163
CENTROID : 637.11
SHAPE : Fwhm = 18.31 Channels Fwtm = 57.87 Channels

ROI # 2-4 RANGE : 669 to 765
AREA : Gross = 7541 Net = 6537 +/- 148
CENTROID : 738.95
SHAPE : Fwhm = 32.11 Channels Fwtm = 57.38 Channels

U and Th Isotope Activities

FILENAME= NP382U.CHN
NP382TH.CHN

Sample # **NOPI-382**
Analyst **JDP**

Sep. date **3/28/95**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.5078	0.4992	454.83	1/22/93	795	445.3986

Th-228/U-232= **0.6108101**

Counting time for Th= **1443.87** (mins.)
Days btwn. sep. and count.= **9** (days)
CF for Th-228= **0.9906188**

Counting time for U= **940.72** (mins.)
Days btwn. sep. and count.= **6** (days)
CF for U-232= **1.0060892**

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
362	43416	11650	6516

U-238 counts	U-234 counts	U-232 counts
7303	6157	2823

Bkgd	Bkgd	Bkgd	bkgd
6	10	23	39

bkgd	bkgd	bkgd
22	16	8

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
356	43406	11034.576	6477

U-238* counts	U-234* counts	U-232sp counts
7281	6141	2797.9626

U-238(dpm/g)= **1139.41** ± **25.25182**
U-234(dpm/g)= **961.01** ± **21.84369**

Th-232(dpm/g)= **8.62842** ± **0.460492**
Th-230(dpm/g)= **1052.037** ± **10.97703**

U-234/U-238= **0.843428** ± **0.014593**
Th-230/U-234= **1.09472** ± **0.014908**
Th-230/Th-232= **121.927** ± **6.435**
U234/Th-232= **111.3773** ± **6.460764**

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

U(ppb)= **1527326**

Th(ppb)= **35312.87**

Spike 25A Spike 25B Spide 25C
10/9/92
Th-228 (dpm/g)= 2723.4657 272.05397 27.191082

NP382U.CHN

MCB # 1 ACQ 04-03-95 AT 14:58:46 RT : 56443.1 LT : 56436.1
No detector description was entered
NOPI-382 U 4/4/95

ROI # 13-1 RANGE : 33 to 145
AREA : Gross = 7625 Net = 7303 +/- 114
CENTROID : 112.97
SHAPE : Fwhm = 45.35 Channels Fwtm = 78.53 Channels

ROI # 13-2 RANGE : 286 to 394
AREA : Gross = 6614 Net = 6157 +/- 118
CENTROID : 360.67
SHAPE : Fwhm = 45.44 Channels Fwtm = 73.71 Channels

ROI # 13-3 RANGE : 547 to 630
AREA : Gross = 3425 Net = 2823 +/- 103
CENTROID : 596.52
SHAPE : Fwhm = 35.58 Channels Fwtm = 58.03 Channels

NP382Th.c HW

MCB # 1 ACQ 04-06-95 AT 06:57:46 RT : 86632.4 LT : 86629.0
No detector description was entered
NOPI-382 Th 4/7/95

ROI # 1-1 RANGE : 27 to 85
AREA : Gross = 450 Net = 362 +/- 34
CENTROID : 62.80
SHAPE : Fwhm = 4.22 Channels Fwtm = 39.66 Channels

ROI # 1-2 RANGE : 231 to 359
AREA : Gross = 43718 Net = 43416 +/- 223
CENTROID : 334.44
SHAPE : Fwhm = 20.69 Channels Fwtm = 57.91 Channels

ROI # 1-3 RANGE : 559 to 651
AREA : Gross = 12597 Net = 11650 +/- 159
CENTROID : 630.54
SHAPE : Fwhm = 18.30 Channels Fwtm = 59.13 Channels

ROI # 1-4 RANGE : 663 to 758
AREA : Gross = 7922 Net = 6516 +/- 166
CENTROID : 730.50
SHAPE : Fwhm = 35.05 Channels Fwtm = 62.11 Channels

U and Th Isotope Activities

FILENAME= NP383U.CHN
NP383TH.CHN

Sample # **NOPI-383**
Analyst **JDP**

Sep. date **3/28/95**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.5059	0.4985	454.83	1/22/93	795	445.3986

Th-228/U-232= **0.6108101**

Counting time for Th= **1444.37** (mins.)
Days btwn. sep. and count.= **9** (days)
CF for Th-228= **0.9906186**

Counting time for U= **940.72** (mins.)
Days btwn. sep. and count.= **6** (days)
CF for U-232= **1.0060892**

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
369	12965	23450	12716

U-238 counts	U-234 counts	U-232 counts
5927	6296	11082

Bkgd	Bkgd	Bkgd	bkgd
3	4	17	27

bkgd	bkgd	bkgd
20	23	21

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
366	12961	22610.03	12689

U-238* counts	U-234* counts	U-232sp counts
5907	6273	10994.055

U-238(dpm/g)= **235.8079** ± **3.794646**
U-234(dpm/g)= **250.4187** ± **3.952075**

Th-232(dpm/g)= **4.339458** ± **0.227674**
Th-230(dpm/g)= **153.6714** ± **1.681804**

U-234/U-238= **1.06196** ± **0.01922**
Th-230/U-234= **0.613658** ± **0.009426**
Th-230/Th-232= **35.41257** ± **1.869555**
U234/Th-232= **57.70736** ± **3.161678**

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

U(ppb)= **316089.6**

Th(ppb)= **17759.77**

Spike 25A Spike 25B Spide 25C
10/9/92
Th-228 (dpm/g)= 2723.4657 272.05397 27.191082

NP383 U. CHW

MCB # 1 ACQ 04-03-95 AT 14:58:46 RT : 56442.9 LT : 56435.9
No detector description was entered
NOPI-383 U 4/4/95

ROI # 14-1 RANGE : 52 to 152
AREA : Gross = 6062 Net = 5927 +/- 90
CENTROID : 122.60
SHAPE : Fwhm = 33.89 Channels Fwtm = 66.08 Channels

ROI # 14-2 RANGE : 296 to 398
AREA : Gross = 6451 Net = 6296 +/- 94
CENTROID : 370.30
SHAPE : Fwhm = 36.95 Channels Fwtm = 65.10 Channels

ROI # 14-3 RANGE : 549 to 634
AREA : Gross = 12100 Net = 11082 +/- 157
CENTROID : 604.55
SHAPE : Fwhm = 41.14 Channels Fwtm = 62.92 Channels

NP383Th.CHW

MCB # 1 ACQ 04-06-95 AT 06:57:46 RT : 86662.3 LT : 86658.9
No detector description was entered
NOPI-383 Th 4/7/95

ROI # 2-1 RANGE : 27 to 91
AREA : Gross = 418 Net = 369 +/- 29
CENTROID : 79.02
SHAPE : Fwhm = 6.49 Channels Fwtm = 43.67 Channels

ROI # 2-2 RANGE : 250 to 360
AREA : Gross = 13131 Net = 12965 +/- 126
CENTROID : 341.29
SHAPE : Fwhm = 19.59 Channels Fwtm = 54.54 Channels

ROI # 2-3 RANGE : 531 to 659
AREA : Gross = 24504 Net = 23450 +/- 212
CENTROID : 637.34
SHAPE : Fwhm = 17.59 Channels Fwtm = 58.35 Channels

ROI # 2-4 RANGE : 673 to 763
AREA : Gross = 13839 Net = 12716 +/- 169
CENTROID : 736.12
SHAPE : Fwhm = 34.75 Channels Fwtm = 61.32 Channels

U and Th Isotope Activities

FILENAME= NP384U.CHN
NP384TH.CHN

Sample # **NOPI-384**
Analyst **JDP**

Sep. date **3/28/95**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.5105	0.4981	454.83	1/22/93	795	445.3986

Th-228/U-232= **0.6108101**

Counting time for Th= **1333.36** (mins.)
Days btwn. sep. and count.= **10** (days)
CF for Th-228= **0.9896742**

Counting time for U= **1453.853** (mins.)
Days btwn. sep. and count.= **7** (days)
CF for U-232= **1.0072187**

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
281	5540	8138	5101

U-238 counts	U-234 counts	U-232 counts
6104	6468	14939

Bkgd	Bkgd	Bkgd	bkgd
6	15	22	36

bkgd	bkgd	bkgd
16	22	13

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
275	5525	7654.4324	5065

U-238* counts	U-234* counts	U-232sp counts
6088	6446	14819.026

U-238(dpm/g)= **178.5355** ± **2.712129**
U-234(dpm/g)= **189.0342** ± **2.813665**

Th-232(dpm/g)= **9.536644** ± **0.578647**
Th-230(dpm/g)= **191.5998** ± **3.337281**

U-234/U-238= **1.058804** ± **0.018894**
Th-230/U-234= **1.013573** ± **0.018555**
Th-230/Th-232= **20.09091** ± **1.228543**
U234/Th-232= **19.82187** ± **1.238375**

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

U(ppb)= **239318.6**

Th(ppb)= **39029.89**

Spike 25A Spike 25B Spide 25C
10/9/92
Th-228 (dpm/g)= 2723.4657 272.05397 27.191082

NP384U.CHW

MCB # 1 ACQ 04-04-95 AT 06:59:02 RT : 87231.2 LT : 87223.9
No detector description was entered
NOPI-384 U 4/5/95

ROI # 7-1 RANGE : 40 to 150
AREA : Gross = 6493 Net = 6104 +/- 114
CENTROID : 127.68
SHAPE : Fwhm = 34.58 Channels Fwtm = 70.93 Channels

ROI # 7-2 RANGE : 285 to 400
AREA : Gross = 6874 Net = 6468 +/- 118
CENTROID : 377.07
SHAPE : Fwhm = 38.23 Channels Fwtm = 71.43 Channels

ROI # 7-3 RANGE : 554 to 638
AREA : Gross = 17106 Net = 14939 +/- 208
CENTROID : 612.94
SHAPE : Fwhm = 36.69 Channels Fwtm = 62.03 Channels

NP384Th.CHW

MCB # 1 ACQ 04-07-95 AT 07:07:36 RT : 80001.7 LT : 80000.0
No detector description was entered
NOPI-384 Th 4/10/95

ROI # 1-1 RANGE : 23 to 85
AREA : Gross = 334 Net = 281 +/- 28
CENTROID : 71.13
SHAPE : Fwhm = 10.79 Channels Fwtm = 20.60 Channels

ROI # 1-2 RANGE : 248 to 356
AREA : Gross = 5884 Net = 5540 +/- 107
CENTROID : 336.10
SHAPE : Fwhm = 15.65 Channels Fwtm = 53.80 Channels

ROI # 1-3 RANGE : 542 to 648
AREA : Gross = 9228 Net = 8138 +/- 163
CENTROID : 632.20
SHAPE : Fwhm = 15.17 Channels Fwtm = 57.90 Channels

ROI # 1-4 RANGE : 674 to 760
AREA : Gross = 5840 Net = 5101 +/- 123
CENTROID : 734.69
SHAPE : Fwhm = 26.64 Channels Fwtm = 54.79 Channels

U and Th Isotope Activities

FILENAME= NP385U.CHN
NP385TH.CHN

Sample # **NOPI-385**
Analyst **JDP**

Sep. date **3/28/95**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.5112	0.5	454.83	1/22/93	795	445.3986

Th-228/U-232= **0.6108101**

Counting time for Th= **1333.36** (mins.)
Days btwn. sep. and count.= **10** (days)
CF for Th-228= **0.9896742**

Counting time for U= **1454.348** (mins.)
Days btwn. sep. and count.= **7** (days)
CF for U-232= **1.0072189**

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
349	6872	10084	6092

U-238 counts	U-234 counts	U-232 counts
4064	4175	11080

Bkgd	Bkgd	Bkgd	bkgd
2	4	16	26

bkgd	bkgd	bkgd
8	7	15

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
347	6868	9501.192	6066

U-238* counts	U-234* counts	U-232sp counts
4056	4168	10985.696

U-238(dpm/g)= **160.8416** ± **2.94966**
U-234(dpm/g)= **165.283** ± **3.001485**

Th-232(dpm/g)= **9.718195** ± **0.529128**
Th-230(dpm/g)= **192.3474** ± **3.008778**

U-234/U-238= **1.027613** ± **0.022644**
Th-230/U-234= **1.163746** ± **0.022836**
Th-230/Th-232= **19.79251** ± **1.086038**
U234/Th-232= **17.00758** ± **0.976163**

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

U(ppb)= **215600.7**

Th(ppb)= **39772.91**

Spike 25A Spike 25B Spide 25C
10/9/92
Th-228 (dpm/g)= 2723.4657 272.05397 27.191082

NP385U.CHN

MCB # 1 ACQ 04-04-95 AT 06:59:02 RT : 87260.9 LT : 87253.6
No detector description was entered
NOPI-385 U 4/5/95

ROI # 8-1 RANGE : 65 to 150
AREA : Gross = 4295 Net = 4064 +/- 85
CENTROID : 125.55
SHAPE : Fwhm = 28.79 Channels Fwtm = 60.11 Channels

ROI # 8-2 RANGE : 313 to 399
AREA : Gross = 4406 Net = 4175 +/- 85
CENTROID : 374.23
SHAPE : Fwhm = 37.29 Channels Fwtm = 61.60 Channels

ROI # 8-3 RANGE : 551 to 639
AREA : Gross = 11747 Net = 11080 +/- 143
CENTROID : 613.34
SHAPE : Fwhm = 37.43 Channels Fwtm = 61.92 Channels

NP385Th-CHN

MCB # 1 ACQ 04-07-95 AT 07:07:36 RT : 80001.7 LT : 80000.0
No detector description was entered
NOPI-385 Th 4/10/95

ROI # 2-1 RANGE : 29 to 92
AREA : Gross = 403 Net = 349 +/- 30
CENTROID : 73.35
SHAPE : Fwhm = 17.18 Channels Fwtm = 41.94 Channels

ROI # 2-2 RANGE : 236 to 361
AREA : Gross = 7439 Net = 6872 +/- 135
CENTROID : 341.22
SHAPE : Fwhm = 20.58 Channels Fwtm = 60.04 Channels

ROI # 2-3 RANGE : 566 to 656
AREA : Gross = 12011 Net = 10084 +/- 193
CENTROID : 637.03
SHAPE : Fwhm = 19.62 Channels Fwtm = 63.65 Channels

ROI # 2-4 RANGE : 674 to 763
AREA : Gross = 7231 Net = 6092 +/- 148
CENTROID : 738.79
SHAPE : Fwhm = 32.12 Channels Fwtm = 58.81 Channels

U and Th Isotope Activities

FILENAME= NP386U.CHN
NP386TH.CHN

Sample # **NOPI-386**
Analyst **JDP**

Sep. date **3/28/95**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.5057	0.5002	454.83	1/22/93	795	445.3986

Th-228/U-232= **0.6108101**

Counting time for Th= **1333.37** (mins.)
Days btwn. sep. and count.= **13** (days)
CF for Th-228= **0.9867333**

Counting time for U= **1454.85** (mins.)
Days btwn. sep. and count.= **7** (days)
CF for U-232= **1.007219**

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
534	7202	13418	9664
Bkgd	Bkgd	Bkgd	bkgd
6	10	22	35

U-238 counts	U-234 counts	U-232 counts
5002	4934	16100
bkgd	bkgd	bkgd
3	5	14

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
528	7192	12530.912	9629

U-238* counts	U-234* counts	U-232sp counts
4999	4929	15970.707

U-238(dpm/g)= **137.8982** ± **2.232213**
U-234(dpm/g)= **135.9672** ± **2.212497**

Th-232(dpm/g)= **11.33854** ± **0.500335**
Th-230(dpm/g)= **154.4446** ± **2.256039**

U-234/U-238= **0.985997** ± **0.019784**
Th-230/U-234= **1.135896** ± **0.020992**
Th-230/Th-232= **13.62121** ± **0.610909**
U234/Th-232= **11.9916** ± **0.563984**

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

U(ppb)= **184846.1**

Th(ppb)= **46404.36**

Spike 25A Spike 25B Spide 25C
10/9/92
Th-228 (dpm/g)= 2723.4657 272.05397 27.191082

NP 386 U-CTW

MCB # 1 ACQ 04-04-95 AT 06:59:02 RT : 87291.0 LT : 87283.7
No detector description was entered
NOPI-386 U 4/5/95

ROI # 9-1 RANGE : 52 to 157
AREA : Gross = 5147 Net = 5002 +/- 86
CENTROID : 133.42
SHAPE : Fwhm = 30.03 Channels Fwtm = 61.96 Channels

ROI # 9-2 RANGE : 307 to 404
AREA : Gross = 5292 Net = 4934 +/- 102
CENTROID : 382.87
SHAPE : Fwhm = 18.40 Channels Fwtm = 59.36 Channels

ROI # 9-3 RANGE : 558 to 642
AREA : Gross = 17659 Net = 16100 +/- 191
CENTROID : 618.69
SHAPE : Fwhm = 20.38 Channels Fwtm = 57.16 Channels

NP 386TH-ctw

MCB # 1 ACQ 04-10-95 AT 07:25:17 RT : 80002.3 LT : 80000.0
No detector description was entered
NOPI-386 Th 4/11/95

ROI # 1-1 RANGE : 23 to 85
AREA : Gross = 535 Net = 534 +/- 23
CENTROID : 70.19
SHAPE : Fwhm = 12.38 Channels Fwtm = 25.44 Channels

ROI # 1-2 RANGE : 269 to 354
AREA : Gross = 7288 Net = 7202 +/- 91
CENTROID : 335.34
SHAPE : Fwhm = 17.61 Channels Fwtm = 49.41 Channels

ROI # 1-3 RANGE : 535 to 658
AREA : Gross = 13815 Net = 13418 +/- 146
CENTROID : 631.48
SHAPE : Fwhm = 15.42 Channels Fwtm = 56.82 Channels

ROI # 1-4 RANGE : 667 to 755
AREA : Gross = 10273 Net = 9664 +/- 134
CENTROID : 732.50
SHAPE : Fwhm = 28.91 Channels Fwtm = 52.89 Channels

U and Th Isotope Activities

FILENAME= NP387U.CHN
NP387TH.CHN

Sample # **NOPI-387**
Analyst **JDP**

Sep. date **3/28/95**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.5098	0.5021	454.83	1/22/93	795	445.3986

Th-228/U-232= 0.6108101

Counting time for Th= 1333.37 (mins.)
Days btwn. sep. and count.= 13 (days)
CF for Th-228= 0.9867333

Counting time for U= 1455.215 (mins.)
Days btwn. sep. and count.= 7 (days)
CF for U-232= 1.0072192

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
501	8000	14328	10514

U-238 counts	U-234 counts	U-232 counts
6921	6926	22870

Bkgd	Bkgd	Bkgd	bkgd
3	4	16	24

bkgd	bkgd	bkgd
1	2	12

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
498	7996	13442.981	10490

U-238* counts	U-234* counts	U-232sp counts
6920	6924	22694.167

U-238(dpm/g)= 133.7615 ± 1.835085
U-234(dpm/g)= 133.8388 ± 1.835637

Th-232(dpm/g)= 9.926113 ± 0.451153
Th-230(dpm/g)= 159.3759 ± 2.224384

U-234/U-238= 1.000578 ± 0.017006
Th-230/U-234= 1.190805 ± 0.019545
Th-230/Th-232= 16.05622 ± 0.73946
U234/Th-232= 13.48351 ± 0.640134

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

U(ppb)= 179301.1

Th(ppb)= 40623.84

Spike 25A Spike 25B Spide 25C
10/9/92
Th-228 (dpm/g)= 2723.4657 272.05397 27.191082

NP387U.CHW

MCB # 1 ACQ 04-04-95 AT 06:59:02 RT : 87312.9 LT : 87305.6
No detector description was entered
NOPI-387 U 4/5/95

ROI # 10-1 RANGE : 28 to 135
AREA : Gross = 7228 Net = 6921 +/- 110
CENTROID : 109.70
SHAPE : Fwhm = 28.33 Channels Fwtm = 66.22 Channels

ROI # 10-2 RANGE : 278 to 384
AREA : Gross = 7211 Net = 6926 +/- 108
CENTROID : 359.59
SHAPE : Fwhm = 37.58 Channels Fwtm = 72.18 Channels

ROI # 10-3 RANGE : 523 to 622
AREA : Gross = 25203 Net = 22870 +/- 244
CENTROID : 594.71
SHAPE : Fwhm = 42.30 Channels Fwtm = 68.79 Channels

WP387Th.c#W

MCB # 1 ACQ 04-10-95 AT 07:25:17 RT : 80002.3 LT : 80000.0
No detector description was entered
NOPI-387 Th 4/11/95

ROI # 2-1 RANGE : 29 to 89
AREA : Gross = 562 Net = 501 +/- 33
CENTROID : 73.99
SHAPE : Fwhm = 24.31 Channels Fwtm = 39.64 Channels

ROI # 2-2 RANGE : 261 to 359
AREA : Gross = 8148 Net = 8000 +/- 101
CENTROID : 340.02
SHAPE : Fwhm = 21.09 Channels Fwtm = 54.09 Channels

ROI # 2-3 RANGE : 541 to 660
AREA : Gross = 15490 Net = 14328 +/- 191
CENTROID : 636.58
SHAPE : Fwhm = 17.95 Channels Fwtm = 60.04 Channels

ROI # 2-4 RANGE : 670 to 760
AREA : Gross = 11560 Net = 10514 +/- 159
CENTROID : 736.80
SHAPE : Fwhm = 32.19 Channels Fwtm = 60.30 Channels

U and Th Isotope Activities

FILENAME= NP388U.CHN
NP388TH.CHN

Sample # **NOPI-388**
Analyst **JDP**

Sep. date **3/27/95**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.5056	0.5029	454.83	1/22/93	794	445.4103

Th-228/U-232= **0.6103678**

Counting time for Th= **1292.48** (mins.)
Days btwn. sep. and count.= **16** (days)
CF for Th-228= **0.9838149**

Counting time for U= **1455.59** (mins.)
Days btwn. sep. and count.= **8** (days)
CF for U-232= **1.0081769**

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
531	4343	13377	10852

U-238 counts	U-234 counts	U-232 counts
2670	3063	16507

Bkgd	Bkgd	Bkgd	bkgd
6	9	21	35

bkgd	bkgd	bkgd
1	7	26

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
525	4334	12467.991	10817

U-238* counts	U-234* counts	U-232sp counts
2669	3056	16347.33

U-238(dpm/g)= **72.33302** ± **1.508819**
U-234(dpm/g)= **82.82117** ± **1.629406**

Th-232(dpm/g)= **11.38648** ± **0.503843**
Th-230(dpm/g)= **93.99806** ± **1.641635**

U-234/U-238= **1.144998** ± **0.030316**
Th-230/U-234= **1.134952** ± **0.026779**
Th-230/Th-232= **8.255238** ± **0.379516**
U234/Th-232= **7.273645** ± **0.352232**

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

U(ppb)= **96959.06**

Th(ppb)= **46600.55**

Spike 25A Spike 25B Spide 25C
10/9/92
Th-228 (dpm/g)= 2721.5653 271.86414 27.172109

NP388U.CHW

MCB # 1 ACQ 04-04-95 AT 06:59:02 RT : 87335.2 LT : 87327.9
No detector description was entered
NOPI-388 U 4/5/95

ROI # 11-1 RANGE : 79 to 163
AREA : Gross = 2755 Net = 2670 +/- 62
CENTROID : 138.53
SHAPE : Fwhm = 23.72 Channels Fwtm = 53.78 Channels

ROI # 11-2 RANGE : 322 to 415
AREA : Gross = 3156 Net = 3063 +/- 67
CENTROID : 388.03
SHAPE : Fwhm = 23.73 Channels Fwtm = 55.11 Channels

ROI # 11-3 RANGE : 560 to 650
AREA : Gross = 17568 Net = 16507 +/- 178
CENTROID : 625.42
SHAPE : Fwhm = 34.09 Channels Fwtm = 56.42 Channels

NP388Th.c HW

MCB # 1 ACQ 04-11-95 AT 09:15:59 RT : 77548.8 LT : 77546.0
No detector description was entered
NOPI-388 Th 4/12/95

ROI # 1-1 RANGE : 26 to 88
AREA : Gross = 563 Net = 531 +/- 29
CENTROID : 70.75
SHAPE : Fwhm = 16.24 Channels Fwtm = 40.03 Channels

ROI # 1-2 RANGE : 267 to 356
AREA : Gross = 4414 Net = 4343 +/- 73
CENTROID : 336.09
SHAPE : Fwhm = 16.86 Channels Fwtm = 49.05 Channels

ROI # 1-3 RANGE : 555 to 656
AREA : Gross = 13938 Net = 13377 +/- 150
CENTROID : 631.45
SHAPE : Fwhm = 16.52 Channels Fwtm = 55.03 Channels

ROI # 1-4 RANGE : 663 to 758
AREA : Gross = 11350 Net = 10852 +/- 135
CENTROID : 733.70
SHAPE : Fwhm = 27.07 Channels Fwtm = 49.33 Channels

U and Th Isotope Activities

FILENAME= NP389U.CHN
NP389TH.CHN

Sample # **NOPI-389**
Analyst **JDP**

Sep. date **3/27/95**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.5056	0.5016	454.83	1/22/93	794	445.4103

Th-228/U-232= **0.6103678**

Counting time for Th= **1293.035** (mins.)
Days btwn. sep. and count.= **16** (days)
CF for Th-228= **0.9838147**

Counting time for U= **1455.985** (mins.)
Days btwn. sep. and count.= **8** (days)
CF for U-232= **1.008177**

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
507	26502	13849	11342

U-238 counts	U-234 counts	U-232 counts
10531	10208	9692

Bkgd	Bkgd	Bkgd	bkgd
2	4	16	26

bkgd	bkgd	bkgd
27	22	24

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
505	26498	12945.959	11316

U-238* counts	U-234* counts	U-232sp counts
10504	10186	9589.5857

U-238(dpm/g)= **484.0226** ± **6.813133**
U-234(dpm/g)= **469.3692** ± **6.656778**

Th-232(dpm/g)= **10.52106** ± **0.475733**
Th-230(dpm/g)= **552.0536** ± **5.788418**

U-234/U-238= **0.969726** ± **0.013469**
Th-230/U-234= **1.176161** ± **0.013701**
Th-230/Th-232= **52.47129** ± **2.352516**
U234/Th-232= **44.61234** ± **2.114142**

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

U(ppb)= **648809.8**

Th(ppb)= **43058.73**

Spike 25A Spike 25B Spide 25C
10/9/92
Th-228 (dpm/g)= 2721.5653 271.86414 27.172109

NP389U.CHW

MCB # 1 ACQ 04-04-95 AT 06:59:02 RT : 87359.1 LT : 87351.9
No detector description was entered
NOPI-389 U 4/5/95

ROI # 12-1 RANGE : 28 to 165
AREA : Gross = 10807 Net = 10531 +/- 129
CENTROID : 125.23
SHAPE : Fwhm = 43.29 Channels Fwtm = 88.03 Channels

ROI # 12-2 RANGE : 282 to 413
AREA : Gross = 10563 Net = 10208 +/- 133
CENTROID : 375.86
SHAPE : Fwhm = 43.73 Channels Fwtm = 80.78 Channels

ROI # 12-3 RANGE : 537 to 646
AREA : Gross = 10723 Net = 9692 +/- 166
CENTROID : 610.80
SHAPE : Fwhm = 46.47 Channels Fwtm = 80.23 Channels

NP389Th.cHN

MCB # 1 ACQ 04-11-95 AT 09:15:59 RT : 77582.1 LT : 77579.4
No detector description was entered
NOPI-389 Th 4/12/95

ROI # 2-1 RANGE : 29 to 95
AREA : Gross = 524 Net = 507 +/- 26
CENTROID : 76.62
SHAPE : Fwhm = 17.97 Channels Fwtm = 44.45 Channels

ROI # 2-2 RANGE : 262 to 364
AREA : Gross = 26692 Net = 26502 +/- 172
CENTROID : 342.25
SHAPE : Fwhm = 18.14 Channels Fwtm = 50.70 Channels

ROI # 2-3 RANGE : 563 to 662
AREA : Gross = 14334 Net = 13849 +/- 146
CENTROID : 638.78
SHAPE : Fwhm = 16.66 Channels Fwtm = 56.03 Channels

ROI # 2-4 RANGE : 677 to 768
AREA : Gross = 12279 Net = 11342 +/- 157
CENTROID : 741.11
SHAPE : Fwhm = 24.76 Channels Fwtm = 48.92 Channels

U and Th Isotope Activities

FILENAME= NP390U.CHN
NP390TH.CHN

Sample # **NOPI-390**
Analyst **JDP**

Sep. date **3/27/95**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.5042	0.5017	454.83	1/22/93	794	445.4103

Th-228/U-232= **0.6103678**

Counting time for Th= **1333.375** (mins.)
Days btwn. sep. and count.= **17** (days)
CF for Th-228= **0.9828256**

Counting time for U= **1456.425** (mins.)
Days btwn. sep. and count.= **8** (days)
CF for U-232= **1.0081772**

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
417	16207	12545	10405

U-238 counts	U-234 counts	U-232 counts
8669	9470	12259

Bkgd	Bkgd	Bkgd	bkgd
6	10	21	35

bkgd	bkgd	bkgd
34	27	17

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
411	16197	11772.637	10370

U-238* counts	U-234* counts	U-232sp counts
8635	9443	12142.707

U-238(dpm/g)= **315.1725** ± **4.42283**
U-234(dpm/g)= **344.6641** ± **4.715344**

Th-232(dpm/g)= **9.444115** ± **0.470104**
Th-230(dpm/g)= **372.1809** ± **4.425898**

U-234/U-238= **1.093573** ± **0.016255**
Th-230/U-234= **1.079837** ± **0.013967**
Th-230/Th-232= **39.40876** ± **1.954525**
U234/Th-232= **36.49512** ± **1.883998**

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

U(ppb)= **422474.2**

Th(ppb)= **38651.2**

Spike 25A Spike 25B Spide 25C
10/9/92
Th-228 (dpm/g)= 2721.5653 271.86414 27.172109

NP3904.CHN

MCB # 1 ACQ 04-04-95 AT 06:59:03 RT : 87385.5 LT : 87378.2
No detector description was entered
NOPI-390 U 4/5/95

ROI # 13-1 RANGE : 34 to 145
AREA : Gross = 9099 Net = 8669 +/- 128
CENTROID : 115.38
SHAPE : Fwhm = 42.27 Channels Fwtm = 70.67 Channels

ROI # 13-2 RANGE : 283 to 393
AREA : Gross = 9841 Net = 9470 +/- 126
CENTROID : 362.38
SHAPE : Fwhm = 44.78 Channels Fwtm = 75.36 Channels

ROI # 13-3 RANGE : 530 to 630
AREA : Gross = 13151 Net = 12259 +/- 162
CENTROID : 597.85
SHAPE : Fwhm = 42.52 Channels Fwtm = 69.14 Channels

NP390Th.CHN

MCB # 1 ACQ 04-12-95 AT 06:56:15 RT : 80002.5 LT : 80000.0
No detector description was entered
NOPI-390 Th 4/13/95

ROI # 1-1 RANGE : 23 to 88
AREA : Gross = 433 Net = 417 +/- 24
CENTROID : 71.31
SHAPE : Fwhm = 8.65 Channels Fwtm = 43.84 Channels

ROI # 1-2 RANGE : 241 to 358
AREA : Gross = 16325 Net = 16207 +/- 136
CENTROID : 334.30
SHAPE : Fwhm = 20.03 Channels Fwtm = 54.69 Channels

ROI # 1-3 RANGE : 553 to 653
AREA : Gross = 13404 Net = 12545 +/- 162
CENTROID : 631.19
SHAPE : Fwhm = 15.47 Channels Fwtm = 56.85 Channels

ROI # 1-4 RANGE : 666 to 758
AREA : Gross = 11135 Net = 10405 +/- 145
CENTROID : 733.95
SHAPE : Fwhm = 27.30 Channels Fwtm = 61.83 Channels

U and Th Isotope Activities

FILENAME= NP391U.CHN
NP391TH.CHN

Sample # **NOPI-391**
Analyst **JDP**

Sep. date **3/27/95**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.5054	0.5042	454.83	1/22/93	794	445.4103

Th-228/U-232= **0.6103678**

Counting time for Th= **1333.375** (mins.)
Days btwn. sep. and count.= **17** (days)
CF for Th-228= **0.9828256**

Counting time for U= **1456.825** (mins.)
Days btwn. sep. and count.= **8** (days)
CF for U-232= **1.0081773**

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
536	4330	13642	11660

U-238 counts	U-234 counts	U-232 counts
2713	3066	17921

Bkgd	Bkgd	Bkgd	bkgd
3	4	17	24

bkgd	bkgd	bkgd
30	30	32

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
533	4326	12702.605	11636

U-238* counts	U-234* counts	U-232sp counts
2683	3036	17743.903

U-238(dpm/g)= **67.18919** ± **1.384156**
U-234(dpm/g)= **76.02922** ± **1.485896**

Th-232(dpm/g)= **11.38031** ± **0.501118**
Th-230(dpm/g)= **92.36623** ± **1.611122**

U-234/U-238= **1.131569** ± **0.029826**
Th-230/U-234= **1.214878** ± **0.028675**
Th-230/Th-232= **8.116323** ± **0.371637**
U234/Th-232= **6.680771** ± **0.321853**

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

U(ppb)= **90063.99**

Th(ppb)= **46575.3**

Spike 25A Spike 25B Spide 25C
10/9/92
Th-228 (dpm/g)= 2721.5653 271.86414 27.172109

NP391U.CHN

MCB # 1 ACQ 04-04-95 AT 06:59:03 RT : 87409.5 LT : 87402.2
No detector description was entered
NOPI-391 U 4/5/95

ROI # 14-1 RANGE : 62 to 147
AREA : Gross = 2820 Net = 2713 +/- 64
CENTROID : 127.10
SHAPE : Fwhm = 17.34 Channels Fwtm = 48.84 Channels

ROI # 14-2 RANGE : 307 to 402
AREA : Gross = 3177 Net = 3066 +/- 69
CENTROID : 377.51
SHAPE : Fwhm = 15.89 Channels Fwtm = 50.51 Channels

ROI # 14-3 RANGE : 554 to 636
AREA : Gross = 18640 Net = 17921 +/- 165
CENTROID : 613.32
SHAPE : Fwhm = 17.09 Channels Fwtm = 51.62 Channels

NP391TH.CHW

MCB # 1 ACQ 04-12-95 AT 06:56:15 RT : 80002.5 LT : 80000.0
No detector description was entered
NOPI-391 Th 4/13/95

ROI # 2-1 RANGE : 26 to 92
AREA : Gross = 553 Net = 536 +/- 27
CENTROID : 75.60
SHAPE : Fwhm = 15.75 Channels Fwtm = 35.00 Channels

ROI # 2-2 RANGE : 263 to 362
AREA : Gross = 4405 Net = 4330 +/- 74
CENTROID : 341.38
SHAPE : Fwhm = 20.69 Channels Fwtm = 56.82 Channels

ROI # 2-3 RANGE : 541 to 658
AREA : Gross = 14723 Net = 13642 +/- 184
CENTROID : 637.71
SHAPE : Fwhm = 19.02 Channels Fwtm = 61.83 Channels

ROI # 2-4 RANGE : 670 to 765
AREA : Gross = 12269 Net = 11660 +/- 144
CENTROID : 740.01
SHAPE : Fwhm = 29.57 Channels Fwtm = 57.91 Channels

U and Th Isotope Activities

FILENAME= NP399U3.CHN
NP399TH3.CHN

Sample # **NOPI-399**
Analyst **JDP**

Sep. date **3/27/95**

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.51	0.5051	454.83	1/22/93	794	445.4103

Th-228/U-232= **0.6103678**

Counting time for Th= **1452.59** (mins.)
Days btwn. sep. and count.= **8** (days)
CF for Th-228= **0.991599**

Counting time for U= **940.73** (mins.)
Days btwn. sep. and count.= **7** (days)
CF for U-232= **1.007048**

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
569	9580	14129	5483
Bkgd	Bkgd	Bkgd	bkgd
6	10	23	36

U-238 counts	U-234 counts	U-232 counts
2396	4413	12239
bkgd	bkgd	bkgd
2	3	9

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
563	9570	13371.371	5447

U-238* counts	U-234* counts	U-232sp counts
2394	4410	12144.406

U-238(dpm/g)= **86.95916** ± **1.942653**
U-234(dpm/g)= **160.1879** ± **2.812698**

Th-232(dpm/g)= **11.33683** ± **0.48474**
Th-230(dpm/g)= **192.7059** ± **2.550429**

U-234/U-238= **1.842105** ± **0.046746**
Th-230/U-234= **1.202999** ± **0.021886**
Th-230/Th-232= **16.99822** ± **0.73346**
U234/Th-232= **14.12987** ± **0.653123**

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

U(ppb)= **116564.7**

Th(ppb)= **46397.36**

Spike 25A Spike 25B Spide 25C
10/9/92
Th-228 (dpm/g)= 2721.5653 271.86414 27.172109

NP399U3.CHW

MCB # 1 ACQ 04-03-95 AT 14:58:45 RT : 56443.8 LT : 56436.8
No detector description was entered
NOPI-399 U 4/4/95

ROI # 9-1 RANGE : 76 to 156
AREA : Gross = 2437 Net = 2396 +/- 54
CENTROID : 134.86
SHAPE : Fwhm = 21.13 Channels Fwtm = 50.36 Channels

ROI # 9-2 RANGE : 332 to 405
AREA : Gross = 4588 Net = 4413 +/- 80
CENTROID : 383.47
SHAPE : Fwhm = 16.03 Channels Fwtm = 45.65 Channels

ROI # 9-3 RANGE : 560 to 643
AREA : Gross = 12685 Net = 12239 +/- 134
CENTROID : 619.68
SHAPE : Fwhm = 18.81 Channels Fwtm = 52.99 Channels

NP399TH3.CHW

MCB # 1 ACQ 04-04-95 AT 06:59:00 RT : 87162.4 LT : 87155.2
No detector description was entered
NOPI-399 Th 4/5/95

ROI # 1-1 RANGE : 28 to 88
AREA : Gross = 571 Net = 569 +/- 24
CENTROID : 74.33
SHAPE : Fwhm = 14.28 Channels Fwtm = 45.23 Channels

ROI # 1-2 RANGE : 265 to 352
AREA : Gross = 9742 Net = 9580 +/- 109
CENTROID : 335.71
SHAPE : Fwhm = 16.94 Channels Fwtm = 48.25 Channels

ROI # 1-3 RANGE : 558 to 651
AREA : Gross = 14564 Net = 14129 +/- 143
CENTROID : 632.32
SHAPE : Fwhm = 14.98 Channels Fwtm = 52.27 Channels

ROI # 1-4 RANGE : 674 to 755
AREA : Gross = 5880 Net = 5483 +/- 103
CENTROID : 733.49
SHAPE : Fwhm = 27.67 Channels Fwtm = 54.18 Channels

U and Th Isotope Activities

FILENAME= NP400U3.CHN
NP400TH3.CHNSample # NOPI-400
Analyst JDP

Sep. date 3/27/95

Sample weight (g)	Spike weight (g)	U-232 (dpm/g)	Ref. date of spike	Days btwn ref. and sep.	U-232* (dpm/g)
0.5021	0.5053	454.83	1/22/93	794	445.4103

Th-228/U-232= 0.6103678

Counting time for Th= 1453.3 (mins.)
Days btwn. sep. and count.= 8 (days)
CF for Th-228= 0.9915988

Counting time for U= 940.73 (mins.)
Days btwn. sep. and count.= 7 (days)
CF for U-232= 1.007048

Th-232 counts	Th-230 counts	Th-228 counts	Ra-224 counts
618	14792	15253	5961

U-238 counts	U-234 counts	U-232 counts
2681	6509	12106

Bkgd	Bkgd	Bkgd	bkgd
3	4	18	30

bkgd	bkgd	bkgd
1	1	8

Th-232* counts	Th-230* counts	Th-228sp counts	Ra-224* counts
615	14788	14432.071	5931

U-238* counts	U-234* counts	U-232sp counts
2680	6508	12013.33

U-238(dpm/g)= 99.99787 ± 2.134431
U-234(dpm/g)= 242.8306 ± 3.732309

Th-232(dpm/g)= 11.6589 ± 0.478396
Th-230(dpm/g)= 280.3443 ± 3.235093

U-234/U-238= 2.428358 ± 0.055727
Th-230/U-234= 1.154485 ± 0.017172
Th-230/Th-232= 24.04553 ± 0.987252
U234/Th-232= 20.82793 ± 0.912615

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

U(ppb)= 134042.5

Th(ppb)= 47715.47

Spike 25A Spike 25B Spide 25C
10/9/92
Th-228 (dpm/g)= 2721.5653 271.86414 27.172109

NP400U3.CHW

MCB # 1 ACQ 04-03-95 AT 14:58:45 RT : 56443.6 LT : 56436.6
No detector description was entered
NOPI-400 U 4/4/95

ROI # 10-1 RANGE : 57 to 137
AREA : Gross = 2761 Net = 2681 +/- 61
CENTROID : 113.04
SHAPE : Fwhm = 22.51 Channels Fwtm = 51.02 Channels

ROI # 10-2 RANGE : 303 to 385
AREA : Gross = 6701 Net = 6509 +/- 95
CENTROID : 360.45
SHAPE : Fwhm = 25.33 Channels Fwtm = 50.35 Channels

ROI # 10-3 RANGE : 541 to 621
AREA : Gross = 12539 Net = 12106 +/- 132
CENTROID : 597.68
SHAPE : Fwhm = 19.34 Channels Fwtm = 53.09 Channels

NP400Th3.c#N

MCB # 1 ACQ 04-04-95 AT 06:59:01 RT : 87198.2 LT : 87190.9
No detector description was entered
NOPI-400 Th 4/5/95

ROI # 2-1 RANGE : 28 to 91
AREA : Gross = 619 Net = 618 +/- 25
CENTROID : 79.34
SHAPE : Fwhm = 8.94 Channels Fwtm = 45.75 Channels

ROI # 2-2 RANGE : 276 to 360
AREA : Gross = 15145 Net = 14792 +/- 139
CENTROID : 341.96
SHAPE : Fwhm = 17.07 Channels Fwtm = 50.71 Channels

ROI # 2-3 RANGE : 562 to 658
AREA : Gross = 15641 Net = 15253 +/- 145
CENTROID : 637.97
SHAPE : Fwhm = 16.85 Channels Fwtm = 55.53 Channels

ROI # 2-4 RANGE : 682 to 764
AREA : Gross = 6293 Net = 5961 +/- 101
CENTROID : 738.41
SHAPE : Fwhm = 26.13 Channels Fwtm = 51.01 Channels

U/Th Digestion (Nopal rock samples)

Sample I. D. # NOPI-137

Date 2/22/95

Acid Digestion by Microwave: This method is useful for total decomposition of many different types of materials including rocks.

1. Consult CEM Microwave Sample Preparation Applications Manual for the microwave sample preparation note for the type of sample (e.g., Fe-oxides, tuff, etc...) to be dissolved. The application note discusses the amount of sample and reagents to be used, and program parameters to be entered for the microwave digestion.

Application Note = 054.

2. Record dry weight of sample = .2548 g and place in a teflon PFA vessel.
3. Using a weighing boat, quantitatively add a known amount of ²³²U/²²⁸Th spike to the PFA vessel.

²³²U/²²⁸Th spike # 2513
_{232u}

Reference Date 1/22/93

Reference Activity 204.88 pCi/g

Spike wt. .5055 g

3. Add reagents to vessel and record volumes:

Reagents	Volume (ml)
<u>HF</u>	<u>7</u>
<u>HCl</u>	<u>3</u>
<u>H₂O₂</u>	<u>1</u>

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.

Extraction:

7. Add 1 ml of perchloric acid (HClO₄) to the sample solution in the teflon beaker. Evaporate to fumes of HClO₄. 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 ~10 mg Fe carrier and coprecipitate actinides by addition of NH₄OH 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.
10. Dissolve the precipitate in ~3 ml conc HCl. Add 1 ml ultrapure water to dilute to ~9M.

Column Separation:

Resin: BIO-RAD Anion Exchange Resin AG 1-X8 100-200 mesh chloride form.
(Lot # 49750A)

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 3/20/95

***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 HNO₃)

Heat Th fraction to evaporate HCl —
Add ~5 ml conc HNO₃ to dissolve residue —
Add equal vol (~5 ml) DI water so soln 8M HNO₃ —
Load onto column in 8M HNO₃ —
Wash 3-4 column vols 8M HNO₃ — — —
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 HNO₃)

Evaporate U fraction to near dryness —
Pick up in about 2 ml conc HNO₃ —
Dilute with about 2 ml DI water to approx 8M HNO₃ —
Load onto column in 8M HNO₃ —
Wash 2 vols (8-10 ml) 8M HNO₃ --> Fe — —
Elute 4-5 vols 0.1M HCl --> U — — — —

Source Preparation:

Thorium - OH⁻ precipitation onto filter

1. Evaporate solution containing Th to near dryness, add ~ 2 ml conc HNO₃ and evaporate to 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 3/24/95

Uranium - F⁻ precipitation onto filter

1. To the solution containing U, add 1 ml of 10% sodium hydrogen sulfate and 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 disappears 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 3/23/95

U/Th Digestion (Nopal rock samples)

Sample I. D. # NOPE-139

Date 2/22/95

Acid Digestion by Microwave: This method is useful for total decomposition of many different types of materials including rocks.

1. Consult CEM Microwave Sample Preparation Applications Manual for the microwave sample preparation note for the type of sample (e.g., Fe-oxides, tuff, etc...) to be dissolved. The application note discusses the amount of sample and reagents to be used, and program parameters to be entered for the microwave digestion.

Application Note = 054

2. Record dry weight of sample = .3173 g and place in a teflon PFA vessel.
3. Using a weighing boat, quantitatively add a known amount of $^{232}\text{U}/^{228}\text{Th}$ spike to the PFA vessel.

$^{232}\text{U}/^{228}\text{Th}$ spike # 2513
 ^{232}U

Reference Date 1/22/93

Reference Activity 204-28 pCi/g

Spike wt. .5041 g

3. Add reagents to vessel and record volumes:

Reagents	Volume (ml)
<u>HF</u>	<u>7</u>
<u>HCl</u>	<u>7</u>
<u>H₂O₂</u>	<u>1</u>

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.

Extraction:

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 ~10 mg 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 scavenge by centrifugation and decant. Wash the precipitate with ultrapure water, centrifuge, and decant. Repeat washing.
10. Dissolve the precipitate in ~3 ml conc HCl. Add 1 ml ultrapure water to dilute to ~9M.

Column Separation:

Resin: BIO-RAD Anion Exchange Resin AG 1-X8 100-200 mesh chloride form.
(Lot # 49750A)

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 3/20/95

***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 HNO₃)

Heat Th fraction to evaporate HCl —
Add ~5 ml conc HNO₃ to dissolve residue —
Add equal vol (~5 ml) DI water so soln 8M HNO₃ —
Load onto column in 8M HNO₃ —
Wash 3-4 column vols 8M HNO₃ — — —
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 HNO₃)

Evaoprate U fraction to near dryness —
Pick up in about 2 ml conc HNO₃ —
Dilute with about 2 ml DI water to approx 8M HNO₃ —
Load onto column in 8M HNO₃ —
Wash 2 vols (8-10 ml) 8M HNO₃ --> Fe — —
Elute 4-5 vols 0.1M HCl --> U — — — —

Source Preparation:

Thorium - OH⁻ precipitation onto filter

1. Evaporate solution containing Th to near dryness, add ~ 2 ml conc HNO₃ and evaporate to 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 3/24/95

Uranium - F⁻ precipitation onto filter

1. To the solution containing U, add 1 ml of 10% sodium hydrogen sulfate and 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 disappears 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 3/23/95

U/Th Digestion (Nopal rock samples)

Sample I. D. # NOPI-142

Date 2/22/95

Acid Digestion by Microwave: This method is useful for total decomposition of many different types of materials including rocks.

1. Consult CEM Microwave Sample Preparation Applications Manual for the microwave sample preparation note for the type of sample (e.g., Fe-oxides, tuff, etc...) to be dissolved. The application note discusses the amount of sample and reagents to be used, and program parameters to be entered for the microwave digestion.

Application Note = 054

2. Record dry weight of sample = .3726 g and place in a teflon PFA vessel.
3. Using a weighing boat, quantitatively add a known amount of $^{232}\text{U}/^{228}\text{Th}$ spike to the PFA vessel.

$^{232}\text{U}/^{228}\text{Th}$ spike # 2513
232u

Reference Date 1/22/93

Reference Activity 204.88 pCi/g

Spike wt. .5054 g

3. Add reagents to vessel and record volumes:

Reagents	Volume (ml)
<u>HF</u>	<u>7</u>
<u>HCl</u>	<u>3</u>
<u>H₂O₂</u>	<u>1</u>

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.

Extraction:

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 ~10 mg 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 scavenge by centrifugation and decant. Wash the precipitate with ultrapure water, centrifuge, and decant. Repeat washing.
10. Dissolve the precipitate in ~3 ml conc HCl. Add 1 ml ultrapure water to dilute to ~9M.

Column Separation:

Resin: BIO-RAD Anion Exchange Resin AG 1-X8 100-200 mesh chloride form.
(Lot # 49150A)

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 3/20/95

***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 HNO₃)

Heat Th fraction to evaporate HCl —
Add ~5 ml conc HNO₃ to dissolve residue —
Add equal vol (~5 ml) DI water so soln 8M HNO₃ —
Load onto column in 8M HNO₃ —
Wash 3-4 column vols 8M HNO₃ — — —
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 HNO₃)

Evaoprate U fraction to near dryness —
Pick up in about 2 ml conc HNO₃ —
Dilute with about 2 ml DI water to approx 8M HNO₃ —
Load onto column in 8M HNO₃ —
Wash 2 vols (8-10 ml) 8M HNO₃ --> Fe — — —
Elute 4-5 vols 0.1M HCl --> U — — —

Source Preparation:

Thorium - OH⁻ precipitation onto filter

1. Evaporate solution containing Th to near dryness, add ~ 2 ml conc HNO₃ and evaporate to 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 3/27/95

Uranium - F⁻ precipitation onto filter

1. To the solution containing U, add 1 ml of 10% sodium hydrogen sulfate and 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 disappears 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 3/23/95

U/Th Digestion (Nopal rock samples)

Sample I. D. # NOPI-144

Date 2/22/95

Acid Digestion by Microwave: This method is useful for total decomposition of many different types of materials including rocks.

1. Consult CEM Microwave Sample Preparation Applications Manual for the microwave sample preparation note for the type of sample (e.g., Fe-oxides, tuff, etc...) to be dissolved. The application note discusses the amount of sample and reagents to be used, and program parameters to be entered for the microwave digestion.

Application Note = 054

2. Record dry weight of sample = .2510 g and place in a teflon PFA vessel.
3. Using a weighing boat, quantitatively add a known amount of $^{232}\text{U}/^{228}\text{Th}$ spike to the PFA vessel.

$^{232}\text{U}/^{228}\text{Th}$ spike # 25B

Reference Date 1/22/93

^{232}U
Reference Activity 204.80 pCi/g

Spike wt. .5048 g

3. Add reagents to vessel and record volumes:

Reagents	Volume (ml)
<u>HF</u>	<u>7</u>
<u>HCl</u>	<u>3</u>
<u>H₂O₂</u>	<u>1</u>

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.

Extraction:

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 ~10 mg 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 scavage by centrifugation and decant. Wash the precipitate with ultrapure water, centrifuge, and decant. Repeat washing.
10. Dissolve the precipitate in ~3 ml conc HCl. Add 1 ml ultrapure water to dilute to ~9M.

Column Separation:

Resin: BIO-RAD Anion Exchange Resin AG 1-X8 100-200 mesh chloride form.
(Lot # 49750A)

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 3/20/95

***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 HNO₃)

Heat Th fraction to evaporate HCl
Add ~5 ml conc HNO₃ to dissolve residue
Add equal vol (~5 ml) DI water so soln 8M HNO₃
Load onto column in 8M HNO₃
Wash 3-4 column vols 8M HNO₃
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 HNO₃)

Evaoprate U fraction to near dryness
Pick up in about 2 ml conc HNO₃
Dilute with about 2 ml DI water to approx 8M HNO₃
Load onto column in 8M HNO₃
Wash 2 vols (8-10 ml) 8M HNO₃ --> Fe
Elute 4-5 vols 0.1M HCl --> U

Source Preparation:

Thorium - OH⁻ precipitation onto filter

1. Evaporate solution containing Th to near dryness, add ~ 2 ml conc HNO₃ and evaporate to 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 3/27/95

Uranium - F⁻ precipitation onto filter

1. To the solution containing U, add 1 ml of 10% sodium hydrogen sulfate and 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 disappears 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 3/23/95

U/Th Digestion (Nopal rock samples)

Sample I. D. # NOPI-205

Date 2/22/95

Acid Digestion by Microwave: This method is useful for total decomposition of many different types of materials including rocks.

1. Consult CEM Microwave Sample Preparation Applications Manual for the microwave sample preparation note for the type of sample (e.g., Fe-oxides, tuff, etc...) to be dissolved. The application note discusses the amount of sample and reagents to be used, and program parameters to be entered for the microwave digestion.

Application Note = 094

2. Record dry weight of sample = .2548 g and place in a teflon PFA vessel.
3. Using a weighing boat, quantitatively add a known amount of ²³²U/²²⁸Th spike to the PFA vessel.

²³²U/²²⁸Th spike # 25B

Reference Date 1/22/93

²³²U Reference Activity 20488 pCi/g

Spike wt. .5064 g

3. Add reagents to vessel and record volumes:

Reagents	Volume (ml)
<u>HF</u>	<u>7</u>
<u>HCl</u>	<u>3</u>
<u>H₂O₂</u>	<u>1</u>

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.

Extraction:

7. Add 1 ml of perchloric acid (HClO₄) to the sample solution in the teflon beaker. Evaporate to fumes of HClO₄. 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 ~10 mg Fe carrier and coprecipitate actinides by addition of NH₄OH to pH = 7.
****Note:** if sample already contains significant Fe, then Fe carrier does not need to be added.
9. Separate the Fe scavenge by centrifugation and decant. Wash the precipitate with ultrapure water, centrifuge, and decant. Repeat washing.
10. Dissolve the precipitate in ~3 ml conc HCl. Add 1 ml ultrapure water to dilute to ~9M.

Column Separation:

Resin: BIO-RAD Anion Exchange Resin AG 1-X8 100-200 mesh chloride form.
(Lot # 49750A)

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

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Separation Date 3/20/95

***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 HNO₃)

Heat Th fraction to evaporate HCl
Add ~5 ml conc HNO₃ to dissolve residue
Add equal vol (~5 ml) DI water so soln 8M HNO₃
Load onto column in 8M HNO₃
Wash 3-4 column vols 8M HNO₃
Elute 4-5 column vols 9M HCl --> Th

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Uranium Column (Biorad 0.7 cm diameter column with 10 cm resin; prewash with 4-5 column vols 8M HNO₃)

Evaporate U fraction to near dryness
Pick up in about 2 ml conc HNO₃
Dilute with about 2 ml DI water to approx 8M HNO₃
Load onto column in 8M HNO₃
Wash 2 vols (8-10 ml) 8M HNO₃ --> Fe
Elute 4-5 vols 0.1M HCl --> U

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Source Preparation:

Thorium - OH⁻ precipitation onto filter

1. Evaporate solution containing Th to near dryness, add ~ 2 ml conc HNO₃ and evaporate to 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 3/28/95

Uranium - F⁻ precipitation onto filter

1. To the solution containing U, add 1 ml of 10% sodium hydrogen sulfate and 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 disappears 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 3/23/95

U/Th Digestion (Nopal rock samples)

Sample I. D. # NOPI-209

Date 2/22/95

Acid Digestion by Microwave: This method is useful for total decomposition of many different types of materials including rocks.

1. Consult CEM Microwave Sample Preparation Applications Manual for the microwave sample preparation note for the type of sample (e.g., Fe-oxides, tuff, etc...) to be dissolved. The application note discusses the amount of sample and reagents to be used, and program parameters to be entered for the microwave digestion.

Application Note = 034

2. Record dry weight of sample = .0950 g and place in a teflon PFA vessel.
3. Using a weighing boat, quantitatively add a known amount of ²³²U/²²⁸Th spike to the PFA vessel.

²³²U/²²⁸Th spike # 25B

Reference Date 1/22/93

²³²U Reference Activity 204.88 pCi/g

Spike wt. .5064 g

3. Add reagents to vessel and record volumes:

Reagents	Volume (ml)
<u>HF</u>	<u>7</u>
<u>HCl</u>	<u>3</u>
<u>H₂O₂</u>	<u>1</u>

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.

Extraction:

7. Add 1 ml of perchloric acid (HClO₄) to the sample solution in the teflon beaker. Evaporate to fumes of HClO₄. 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 ~10 mg Fe carrier and coprecipitate actinides by addition of NH₄OH 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.
10. Dissolve the precipitate in ~3 ml conc HCl. Add 1 ml ultrapure water to dilute to ~9M.

Column Separation:

Resin: BIO-RAD Anion Exchange Resin AG 1-X8 100-200 mesh chloride form.
(Lot # 49750A)

Main Column (Biorad 1.5 cm diameter column with 10 cm resin; prewash with 4-5 column voils 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

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Separation Date 3/20/95

***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 voils 8M HNO₃)

Heat Th fraction to evaporate HCl
Add ~5 ml conc HNO₃ to dissolve residue
Add equal vol (~5 ml) DI water so soln 8M HNO₃
Load onto column in 8M HNO₃
Wash 3-4 column voils 8M HNO₃
Elute 4-5 column voils 9M HCl --> Th

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Uranium Column (Biorad 0.7 cm diameter column with 10 cm resin; prewash with 4-5 column voils 8M HNO₃)

Evaoprate U fraction to near dryness
Pick up in about 2 ml conc HNO₃
Dilute with about 2 ml DI water to approx 8M HNO₃
Load onto column in 8M HNO₃
Wash 2 voils (8-10 ml) 8M HNO₃ --> Fe
Elute 4-5 voils 0.1M HCl --> U

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Source Preparation:

Thorium - OH⁻ precipitation onto filter

1. Evaporate solution containing Th to near dryness, add ~ 2 ml conc HNO₃ and evaporate to 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 3/28/95

Uranium - F⁻ precipitation onto filter

1. To the solution containing U, add 1 ml of 10% sodium hydrogen sulfate and 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 disappears 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 3/23/95

U/Th Digestion (Nopal rock samples)

Sample I. D. # NOPI-298

Date 2/22/95

Acid Digestion by Microwave: This method is useful for total decomposition of many different types of materials including rocks.

1. Consult CEM Microwave Sample Preparation Applications Manual for the microwave sample preparation note for the type of sample (e.g., Fe-oxides, tuff, etc...) to be dissolved. The application note discusses the amount of sample and reagents to be used, and program parameters to be entered for the microwave digestion.

Application Note = 094.

2. Record dry weight of sample = .2999 g and place in a teflon PFA vessel.
3. Using a weighing boat, quantitatively add a known amount of $^{232}\text{U}/^{228}\text{Th}$ spike to the PFA vessel.

$^{232}\text{U}/^{228}\text{Th}$ spike # 2513
232u
Reference Activity 204.81 pCi/g

Reference Date 1/22/93
Spike wt. .5056 g

3. Add reagents to vessel and record volumes:

Reagents	Volume (ml)
<u>HF</u>	<u>7</u>
<u>HCl</u>	<u>3</u>
<u>H₂O₂</u>	<u>1</u>

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.

Extraction:

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 ~10 mg 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.
10. Dissolve the precipitate in ~3 ml conc HCl. Add 1 ml ultrapure water to dilute to ~9M.

Column Separation:

Resin: BIO-RAD Anion Exchange Resin AG 1-X8 100-200 mesh chloride form.
(Lot # 49750A)

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

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Separation Date 3/20/95

***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 HNO₃)

Heat Th fraction to evaporate HCl
Add ~5 ml conc HNO₃ to dissolve residue
Add equal vol (~5 ml) DI water so soln 8M HNO₃
Load onto column in 8M HNO₃
Wash 3-4 column vols 8M HNO₃
Elute 4-5 column vols 9M HCl --> Th

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Uranium Column (Biorad 0.7 cm diameter column with 10 cm resin; prewash with 4-5 column vols 8M HNO₃)

Evaporate U fraction to near dryness
Pick up in about 2 ml conc HNO₃
Dilute with about 2 ml DI water to approx 8M HNO₃
Load onto column in 8M HNO₃
Wash 2 vols (8-10 ml) 8M HNO₃ --> Fe
Elute 4-5 vols 0.1M HCl --> U

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Source Preparation:

Thorium - OH⁻ precipitation onto filter

1. Evaporate solution containing Th to near dryness, add ~ 2 ml conc HNO₃ and evaporate to 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 2/29/95

Uranium - F⁻ precipitation onto filter

1. To the solution containing U, add 1 ml of 10% sodium hydrogen sulfate and 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 disappears 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 3/23/95

U/Th Digestion (Nopal rock samples)

Sample I. D. # WOP I-302

Date 2/22/95

Acid Digestion by Microwave: This method is useful for total decomposition of many different types of materials including rocks.

1. Consult CEM Microwave Sample Preparation Applications Manual for the microwave sample preparation note for the type of sample (e.g., Fe-oxides, tuff, etc...) to be dissolved. The application note discusses the amount of sample and reagents to be used, and program parameters to be entered for the microwave digestion.

Application Note = 074

2. Record dry weight of sample = .4394 g and place in a teflon PFA vessel.
3. Using a weighing boat, quantitatively add a known amount of ²³²U/²²⁸Th spike to the PFA vessel.

²³²U/²²⁸Th spike # 25B
_{²³²U}

Reference Date 1/22/93

Reference Activity 204.88 pCi/g

Spike wt. .5045 g

3. Add reagents to vessel and record volumes:

Reagents	Volume (ml)
<u>HF</u>	<u>7</u>
<u>HCl</u>	<u>3</u>
<u>H₂O₂</u>	<u>1</u>

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.

Extraction:

7. Add 1 ml of perchloric acid (HClO₄) to the sample solution in the teflon beaker. Evaporate to fumes of HClO₄. 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 ~10 mg Fe carrier and coprecipitate actinides by addition of NH₄OH to pH = 7.
**Note: if sample already contains significant Fe, then Fe carrier does not need to be added.
9. Separate the Fe scavage by centrifugation and decant. Wash the precipitate with ultrapure water, centrifuge, and decant. Repeat washing.
10. Dissolve the precipitate in ~3 ml conc HCl. Add 1 ml ultrapure water to dilute to ~9M.

Column Separation:

Resin: BIO-RAD Anion Exchange Resin AG 1-X8 100-200 mesh chloride form.
(Lot # 49750A)

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 3/20/95

***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 HNO₃)

Heat Th fraction to evaporate HCl
Add ~5 ml conc HNO₃ to dissolve residue
Add equal vol (~5 ml) DI water so soln 8M HNO₃
Load onto column in 8M HNO₃
Wash 3-4 column vols 8M HNO₃
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 HNO₃)

Evaoprate U fraction to near dryness
Pick up in about 2 ml conc HNO₃
Dilute with about 2 ml DI water to approx 8M HNO₃
Load onto column in 8M HNO₃
Wash 2 vols (8-10 ml) 8M HNO₃ --> Fe
Elute 4-5 vols 0.1M HCl --> U

Source Preparation:

Thorium - OH⁻ precipitation onto filter

1. Evaporate solution containing Th to near dryness, add ~ 2 ml conc HNO₃ and evaporate to 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 2/29/95

Uranium - F⁻ precipitation onto filter

1. To the solution containing U, add 1 ml of 10% sodium hydrogen sulfate and 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 substate 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 3/23/95

U/Th Digestion (Nopal rock samples)

Sample I. D. # NOPI-372

Date 1/26/95

Acid Digestion by Microwave: This method is useful for total decomposition of many different types of materials including rocks.

1. Consult CEM Microwave Sample Preparation Applications Manual for the microwave sample preparation note for the type of sample (e.g., Fe-oxides, tuff, etc...) to be dissolved. The application note discusses the amount of sample and reagents to be used, and program parameters to be entered for the microwave digestion.

Application Note = 05-4

2. Record dry weight of sample = .4962 g and place in a teflon PFA vessel.
3. Using a weighing boat, quantitatively add a known amount of $^{232}\text{U}/^{228}\text{Th}$ spike to the PFA vessel.

$^{232}\text{U}/^{228}\text{Th}$ spike # 25B
232u

Reference Date 1/22/93

Reference Activity 204.38 pCi/g

Spike wt. 1.0018 g

3. Add reagents to vessel and record volumes:

Reagents	Volume (ml)
<u>HF</u>	<u>7</u>
<u>HCl</u>	<u>3</u>
<u>HNO₃</u>	<u>1</u>

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.

Extraction:

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 ~10 mg 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.
10. Dissolve the precipitate in ~3 ml conc HCl. Add 1 ml ultrapure water to dilute to ~9M.

Column Separation:

Resin: BIO-RAD Anion Exchange Resin AG 1-X8 100-200 mesh chloride form.

(Lot # 49750A)

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 2/23/95

***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 HNO₃)

Heat Th fraction to evaporate HCl _____
Add ~5 ml conc HNO₃ to dissolve residue _____
Add equal vol (~5 ml) DI water so soln 8M HNO₃ _____
Load onto column in 8M HNO₃ _____
Wash 3-4 column vols 8M HNO₃ _____
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 HNO₃)

Evaoprate U fraction to near dryness _____
Pick up in about 2 ml conc HNO₃ _____
Dilute with about 2 ml DI water to approx 8M HNO₃ _____
Load onto column in 8M HNO₃ _____
Wash 2 vols (8-10 ml) 8M HNO₃ --> Fe _____
Elute 4-5 vols 0.1M HCl --> U _____

Source Preparation:

Thorium - OH⁻ precipitation onto filter

1. Evaporate solution containing Th to near dryness, add ~ 2 ml conc HNO₃ and evaporate to 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

2/28/95

Uranium - F⁻ precipitation onto filter

1. To the solution containing U, add 1 ml of 10% sodium hydrogen sulfate and 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 disappears 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

2/27/95

U/Th Digestion (Nopal rock samples)

Sample I. D. # NOPI-373

Date 1/26/95

Acid Digestion by Microwave: This method is useful for total decomposition of many different types of materials including rocks.

1. Consult CEM Microwave Sample Preparation Applications Manual for the microwave sample preparation note for the type of sample (e.g., Fe-oxides, tuff, etc...) to be dissolved. The application note discusses the amount of sample and reagents to be used, and program parameters to be entered for the microwave digestion.

Application Note = 05-4

2. Record dry weight of sample = .5068 g and place in a teflon PFA vessel.
3. Using a weighing boat, quantitatively add a known amount of ²³²U/²²⁸Th spike to the PFA vessel.

²³²U/²²⁸Th spike # 25B
232u

Reference Date 1/22/93

Reference Activity 204.88 pCi/g

Spike wt. 1.0021 g

3. Add reagents to vessel and record volumes:

Reagents	Volume (ml)
<u>HF</u>	<u>7</u>
<u>HCl</u>	<u>3</u>
<u>HNO₃</u>	<u>1</u>

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.

Extraction:

7. Add 1 ml of perchloric acid (HClO₄) to the sample solution in the teflon beaker. Evaporate to fumes of HClO₄. 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 ~10 mg Fe carrier and coprecipitate actinides by addition of NH₄OH 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.
10. Dissolve the precipitate in ~3 ml conc HCl. Add 1 ml ultrapure water to dilute to ~9M.

Column Separation:

Resin: BIO-RAD Anion Exchange Resin AG 1-X8 100-200 mesh chloride form.
(Lot # 49750A)

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 2/23/95

***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 HNO₃)

Heat Th fraction to evaporate HCl
Add ~5 ml conc HNO₃ to dissolve residue
Add equal vol (~5 ml) DI water so soln 8M HNO₃
Load onto column in 8M HNO₃
Wash 3-4 column vols 8M HNO₃
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 HNO₃)

Evaoprate U fraction to near dryness
Pick up in about 2 ml conc HNO₃
Dilute with about 2 ml DI water to approx 8M HNO₃
Load onto column in 8M HNO₃
Wash 2 vols (8-10 ml) 8M HNO₃ --> Fe
Elute 4-5 vols 0.1M HCl --> U

Source Preparation:

Thorium - OH⁻ precipitation onto filter

1. Evaporate solution containing Th to near dryness, add ~ 2 ml conc HNO₃ and evaporate to 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 μ l 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 μ g 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 2/28/95

Uranium - F⁻ precipitation onto filter

1. To the solution containing U, add 1 ml of 10% sodium hydrogen sulfate and 50 μ g 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 disappears 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 2/27/95

U/Th Digestion (Nopal rock samples)

Sample I. D. # NOPI-374

Date 2/1/95

Acid Digestion by Microwave: This method is useful for total decomposition of many different types of materials including rocks.

1. Consult CEM Microwave Sample Preparation Applications Manual for the microwave sample preparation note for the type of sample (e.g., Fe-oxides, tuff, etc...) to be dissolved. The application note discusses the amount of sample and reagents to be used, and program parameters to be entered for the microwave digestion.

Application Note = 05-4

2. Record dry weight of sample = .5120 g and place in a teflon PFA vessel.
3. Using a weighing boat, quantitatively add a known amount of ²³²U/²²⁸Th spike to the PFA vessel.

²³²U/²²⁸Th spike # 25B

Reference Date 1/22/93

²³²U
Reference Activity 204.88 pCi/g

Spike wt. .4995 g

3. Add reagents to vessel and record volumes:

Reagents	Volume (ml)
<u>HF</u>	<u>7</u>
<u>HCl</u>	<u>3</u>
<u>H₂O₂</u>	<u>1</u>

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.

Extraction:

7. Add 1 ml of perchloric acid (HClO₄) to the sample solution in the teflon beaker. Evaporate to fumes of HClO₄. 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 ~10 mg Fe carrier and coprecipitate actinides by addition of NH₄OH to pH = 7.
****Note:** if sample already contains significant Fe, then Fe carrier does not need to be added.
9. Separate the Fe scavage by centrifugation and decant. Wash the precipitate with ultrapure water, centrifuge, and decant. Repeat washing.
10. Dissolve the precipitate in ~3 ml conc HCl. Add 1 ml ultrapure water to dilute to ~9M.

Column Separation:

Resin: BIO-RAD Anion Exchange Resin AG 1-X8 100-200 mesh chloride form.
(Lot # 49750A)

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 2/23/95

***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 HNO₃)

Heat Th fraction to evaporate HCl
Add ~5 ml conc HNO₃ to dissolve residue
Add equal vol (~5 ml) DI water so soln 8M HNO₃
Load onto column in 8M HNO₃
Wash 3-4 column vols 8M HNO₃
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 HNO₃)

Evaoprte U fraction to near dryness
Pick up in about 2 ml conc HNO₃
Dilute with about 2 ml DI water to approx 8M HNO₃
Load onto column in 8M HNO₃
Wash 2 vols (8-10 ml) 8M HNO₃ --> Fe
Elute 4-5 vols 0.1M HCl --> U

Source Preparation:

Thorium - OH⁻ precipitation onto filter

1. Evaporate solution containing Th to near dryness, add ~ 2 ml conc HNO₃ and evaporate to 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

3/1/95
2/28/95

Uranium - F⁻ precipitation onto filter

1. To the solution containing U, add 1 ml of 10% sodium hydrogen sulfate and 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 substate 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

2/27/95

U/Th Digestion (Nopal rock samples)

Sample I. D. # NOPI-375

Date 2/1/95

Acid Digestion by Microwave: This method is useful for total decomposition of many different types of materials including rocks.

1. Consult CEM Microwave Sample Preparation Applications Manual for the microwave sample preparation note for the type of sample (e.g., Fe-oxides, tuff, etc...) to be dissolved. The application note discusses the amount of sample and reagents to be used, and program parameters to be entered for the microwave digestion.

Application Note = 054

2. Record dry weight of sample = .5113 g and place in a teflon PFA vessel.
3. Using a weighing boat, quantitatively add a known amount of $^{232}\text{U}/^{228}\text{Th}$ spike to the PFA vessel.

$^{232}\text{U}/^{228}\text{Th}$ spike # 25B
232u
Reference Activity 204.88 pCi/g

Reference Date 1/22/93
Spike wt. .9868 g

3. Add reagents to vessel and record volumes:

Reagents	Volume (ml)
<u>HF</u>	<u>7</u>
<u>HCl</u>	<u>3</u>
<u>HNO₃</u>	<u>1</u>

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.

Extraction:

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 ~10 mg 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 scavage by centrifugation and decant. Wash the precipitate with ultrapure water, centrifuge, and decant. Repeat washing.
10. Dissolve the precipitate in ~3 ml conc HCl. Add 1 ml ultrapure water to dilute to ~9M.

Column Separation:

Resin: BIO-RAD Anion Exchange Resin AG 1-X8 100-200 mesh chloride form.
(Lot # 49750A)

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 2/23/95

***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 HNO₃)

Heat Th fraction to evaporate HCl _____
Add ~5 ml conc HNO₃ to dissolve residue _____
Add equal vol (~5 ml) DI water so soln 8M HNO₃ _____
Load onto column in 8M HNO₃ _____
Wash 3-4 column vols 8M HNO₃ _____
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 HNO₃)

Evaoprate U fraction to near dryness _____
Pick up in about 2 ml conc HNO₃ _____
Dilute with about 2 ml DI water to approx 8M HNO₃ _____
Load onto column in 8M HNO₃ _____
Wash 2 vols (8-10 ml) 8M HNO₃ --> Fe _____
Elute 4-5 vols 0.1M HCl --> U _____

Source Preparation:

Thorium - OH⁻ precipitation onto filter

1. Evaporate solution containing Th to near dryness, add ~ 2 ml conc HNO₃ and evaporate to 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.

3/1/95
Th Counting Date 2/27/95

Uranium - F⁻ precipitation onto filter

1. To the solution containing U, add 1 ml of 10% sodium hydrogen sulfate and 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 disappears 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 2/27/95

U/Th Digestion (Nopal rock samples)

Sample I. D. # NOPI-376

Date 2/1/95

Acid Digestion by Microwave: This method is useful for total decomposition of many different types of materials including rocks.

1. Consult CEM Microwave Sample Preparation Applications Manual for the microwave sample preparation note for the type of sample (e.g., Fe-oxides, tuff, etc...) to be dissolved. The application note discusses the amount of sample and reagents to be used, and program parameters to be entered for the microwave digestion.

Application Note = 054

2. Record dry weight of sample = .5068 g and place in a teflon PFA vessel.
3. Using a weighing boat, quantitatively add a known amount of ²³²U/²²⁸Th spike to the PFA vessel.

²³²U/²²⁸Th spike # 253
232u

Reference Date 1/22/93

Reference Activity 204.88 pCi/g

Spike wt. .9862 g

3. Add reagents to vessel and record volumes:

Reagents	Volume (ml)
<u>HF</u>	<u>7</u>
<u>HCl</u>	<u>3</u>
<u>H₂O₂</u>	<u>1</u>

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.

Extraction:

7. Add 1 ml of perchloric acid (HClO₄) to the sample solution in the teflon beaker. Evaporate to fumes of HClO₄. 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 ~10 mg Fe carrier and coprecipitate actinides by addition of NH₄OH to pH = 7.
**Note: if sample already contains significant Fe, then Fe carrier does not need to be added.
9. Separate the Fe scavage by centrifugation and decant. Wash the precipitate with ultrapure water, centrifuge, and decant. Repeat washing.
10. Dissolve the precipitate in ~3 ml conc HCl. Add 1 ml ultrapure water to dilute to ~9M.

Column Separation:

Resin: BIO-RAD Anion Exchange Resin AG 1-X8 100-200 mesh chloride form.
(Lot # 49750A)

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 2/23/95

***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 HNO₃)

Heat Th fraction to evaporate HCl _____
Add ~5 ml conc HNO₃ to dissolve residue _____
Add equal vol (~5 ml) DI water so soln 8M HNO₃ _____
Load onto column in 8M HNO₃ _____
Wash 3-4 column vols 8M HNO₃ _____
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 HNO₃)

Evaoprate U fraction to near dryness _____
Pick up in about 2 ml conc HNO₃ _____
Dilute with about 2 ml DI water to approx 8M HNO₃ _____
Load onto column in 8M HNO₃ _____
Wash 2 vols (8-10 ml) 8M HNO₃ --> Fe _____
Elute 4-5 vols 0.1M HCl --> U _____

Source Preparation:

Thorium - OH⁻ precipitation onto filter

1. Evaporate solution containing Th to near dryness, add ~ 2 ml conc HNO₃ and evaporate to 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

3/1/95
~~2/28/95~~

Uranium - F⁻ precipitation onto filter

1. To the solution containing U, add 1 ml of 10% sodium hydrogen sulfate and 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 disappears 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

2/27/95

U/Th Digestion (Nopal rock samples)

Sample I. D. # NOPI-377

Date 2/1/95

Acid Digestion by Microwave: This method is useful for total decomposition of many different types of materials including rocks.

1. Consult CEM Microwave Sample Preparation Applications Manual for the microwave sample preparation note for the type of sample (e.g., Fe-oxides, tuff, etc...) to be dissolved. The application note discusses the amount of sample and reagents to be used, and program parameters to be entered for the microwave digestion.

Application Note = 054

2. Record dry weight of sample = .5159 g and place in a teflon PFA vessel.
3. Using a weighing boat, quantitatively add a known amount of $^{232}\text{U}/^{228}\text{Th}$ spike to the PFA vessel.

$^{232}\text{U}/^{228}\text{Th}$ spike # 2513
232u
Reference Activity 204.88 pCi/g

Reference Date 1/22/93
Spike wt. .9844 g

3. Add reagents to vessel and record volumes:

Reagents	Volume (ml)
<u>HF</u>	<u>7</u>
<u>HCl</u>	<u>3</u>
<u>H₂O₂</u>	<u>1</u>

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.

Extraction:

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 ~10 mg 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 scavage by centrifugation and decant. Wash the precipitate with ultrapure water, centrifuge, and decant. Repeat washing.
10. Dissolve the precipitate in ~3 ml conc HCl. Add 1 ml ultrapure water to dilute to ~9M.

Column Separation:

Resin: BIO-RAD Anion Exchange Resin AG 1-X8 100-200 mesh chloride form.
(Lot # 4975DA)

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 2/23/95

***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 HNO₃)

Heat Th fraction to evaporate HCl _____
Add ~5 ml conc HNO₃ to dissolve residue _____
Add equal vol (~5 ml) DI water so soln 8M HNO₃ _____
Load onto column in 8M HNO₃ _____
Wash 3-4 column vols 8M HNO₃ _____
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 HNO₃)

Evaoprate U fraction to near dryness _____
Pick up in about 2 ml conc HNO₃ _____
Dihute with about 2 ml DI water to approx 8M HNO₃ _____
Load onto column in 8M HNO₃ _____
Wash 2 vols (8-10 ml) 8M HNO₃ --> Fe _____
Elute 4-5 vols 0.1M HCl --> U _____

Source Preparation:

Thorium - OH⁻ precipitation onto filter

1. Evaporate solution containing Th to near dryness, add ~ 2 ml conc HNO₃ and evaporate to 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

3/1/95
2/28/95

Uranium - F⁻ precipitation onto filter

1. To the solution containing U, add 1 ml of 10% sodium hydrogen sulfate and 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 disappears 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

2/27/95

U/Th Digestion (Nopal rock samples)

Sample I. D. # NOPT-370

Date 2/13/95

Acid Digestion by Microwave: This method is useful for total decomposition of many different types of materials including rocks.

1. Consult CEM Microwave Sample Preparation Applications Manual for the microwave sample preparation note for the type of sample (e.g., Fe-oxides, tuff, etc...) to be dissolved. The application note discusses the amount of sample and reagents to be used, and program parameters to be entered for the microwave digestion.

Application Note = 05-4

2. Record dry weight of sample = .5059 g and place in a teflon PFA vessel.
3. Using a weighing boat, quantitatively add a known amount of $^{232}\text{U}/^{228}\text{Th}$ spike to the PFA vessel.

$^{232}\text{U}/^{228}\text{Th}$ spike # 25B
232u
Reference Activity 204.00 pCi/g

Reference Date 1/22/93
Spike wt. .5004 g

3. Add reagents to vessel and record volumes:

Reagents	Volume (ml)
<u>HF</u>	<u>7</u>
<u>HCl</u>	<u>3</u>
<u>HNO₃</u>	<u>1</u>

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.

Extraction:

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 ~10 mg 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 scavenge by centrifugation and decant. Wash the precipitate with ultrapure water, centrifuge, and decant. Repeat washing.
10. Dissolve the precipitate in ~3 ml conc HCl. Add 1 ml ultrapure water to dilute to ~9M.

Column Separation:

Resin: BIO-RAD Anion Exchange Resin AG 1-X8 100-200 mesh chloride form.
(Lot # 49750A)

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 2/23/95

***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 HNO₃)

Heat Th fraction to evaporate HCl _____
Add ~5 ml conc HNO₃ to dissolve residue _____
Add equal vol (~5 ml) DI water so soln 8M HNO₃ _____
Load onto column in 8M HNO₃ _____
Wash 3-4 column vols 8M HNO₃ _____
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 HNO₃)

Evaoprate U fraction to near dryness _____
Pick up in about 2 ml conc HNO₃ _____
Dilute with about 2 ml DI water to approx 8M HNO₃ _____
Load onto column in 8M HNO₃ _____
Wash 2 vols (8-10 ml) 8M HNO₃ --> Fe _____
Elute 4-5 vols 0.1M HCl --> U _____

Source Preparation:

Thorium - OH⁻ precipitation onto filter

1. Evaporate solution containing Th to near dryness, add ~ 2 ml conc HNO₃ and evaporate to 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 3/2/95
2/28/95

Uranium - F⁻ precipitation onto filter

1. To the solution containing U, add 1 ml of 10% sodium hydrogen sulfate and 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 disappears 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 2/27/95

U/Th Digestion (Nopal rock samples)

Sample I. D. # NOPT-379

Date 2/13/95

Acid Digestion by Microwave: This method is useful for total decomposition of many different types of materials including rocks.

1. Consult CEM Microwave Sample Preparation Applications Manual for the microwave sample preparation note for the type of sample (e.g., Fe-oxides, tuff, etc...) to be dissolved. The application note discusses the amount of sample and reagents to be used, and program parameters to be entered for the microwave digestion.

Application Note = 05-4

2. Record dry weight of sample = .5017 g and place in a teflon PFA vessel.
3. Using a weighing boat, quantitatively add a known amount of ²³²U/²²⁸Th spike to the PFA vessel.

²³²U/²²⁸Th spike # 25B
_{232u}
 Reference Activity 204.88 pCi/g

Reference Date 1/22/93
 Spike wt. .4980 g

3. Add reagents to vessel and record volumes:

Reagents	Volume (ml)
<u>HF</u>	<u>7</u>
<u>HCl</u>	<u>3</u>
<u>HNO₃</u>	<u>1</u>

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.

Extraction:

7. Add 1 ml of perchloric acid (HClO₄) to the sample solution in the teflon beaker. Evaporate to fumes of HClO₄. 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 ~10 mg Fe carrier and coprecipitate actinides by addition of NH₄OH 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.
10. Dissolve the precipitate in ~3 ml conc HCl. Add 1 ml ultrapure water to dilute to ~9M.

Column Separation:

Resin: BIO-RAD Anion Exchange Resin AG 1-X8 100-200 mesh chloride form.
(Lot # 49750A)

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

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Separation Date 2/23/95

***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 HNO₃)

Heat Th fraction to evaporate HCl
Add ~5 ml conc HNO₃ to dissolve residue
Add equal vol (~5 ml) DI water so soln 8M HNO₃
Load onto column in 8M HNO₃
Wash 3-4 column vols 8M HNO₃
Elute 4-5 column vols 9M HCl --> Th

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Uranium Column (Biorad 0.7 cm diameter column with 10 cm resin; prewash with 4-5 column vols 8M HNO₃)

Evaoprate U fraction to near dryness
Pick up in about 2 ml conc HNO₃
Dilute with about 2 ml DI water to approx 8M HNO₃
Load onto column in 8M HNO₃
Wash 2 vols (8-10 ml) 8M HNO₃ --> Fe
Elute 4-5 vols 0.1M HCl --> U

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Source Preparation:

Thorium - OH⁻ precipitation onto filter

1. Evaporate solution containing Th to near dryness, add ~ 2 ml conc HNO₃ and evaporate to 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

3/1/95
2/28/95

Uranium - F⁻ precipitation onto filter

1. To the solution containing U, add 1 ml of 10% sodium hydrogen sulfate and 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 disappears 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

2/27/95

U/Th Digestion (Nopal rock samples)

Sample I. D. # NOPI-380

Date 2/13/95

Acid Digestion by Microwave: This method is useful for total decomposition of many different types of materials including rocks.

1. Consult CEM Microwave Sample Preparation Applications Manual for the microwave sample preparation note for the type of sample (e.g., Fe-oxides, tuff, etc...) to be dissolved. The application note discusses the amount of sample and reagents to be used, and program parameters to be entered for the microwave digestion.

Application Note = 054

2. Record dry weight of sample = .5090 g and place in a teflon PFA vessel.
3. Using a weighing boat, quantitatively add a known amount of $^{232}\text{U}/^{228}\text{Th}$ spike to the PFA vessel.

$^{232}\text{U}/^{228}\text{Th}$ spike # 25B
232u
Reference Activity 204.88 pCi/g

Reference Date 1/22/93
Spike wt. .4964 g

3. Add reagents to vessel and record volumes:

Reagents	Volume (ml)
<u>HF</u>	<u>7</u>
<u>HCl</u>	<u>2</u>
<u>HNO₃</u>	<u>1</u>

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.

Extraction:

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 ~10 mg 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.
10. Dissolve the precipitate in ~3 ml conc HCl. Add 1 ml ultrapure water to dilute to ~9M.

Column Separation:

Resin: BIO-RAD Anion Exchange Resin AG 1-X8 100-200 mesh chloride form.
(Lot # 497507)

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

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Separation Date 3/28/95

***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 HNO₃)

Heat Th fraction to evaporate HCl
Add ~5 ml conc HNO₃ to dissolve residue
Add equal vol (~5 ml) DI water so soln 8M HNO₃
Load onto column in 8M HNO₃
Wash 3-4 column vols 8M HNO₃
Elute 4-5 column vols 9M HCl --> Th

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Uranium Column (Biorad 0.7 cm diameter column with 10 cm resin; prewash with 4-5 column vols 8M HNO₃)

Evaporate U fraction to near dryness
Pick up in about 2 ml conc HNO₃
Dilute with about 2 ml DI water to approx 8M HNO₃
Load onto column in 8M HNO₃
Wash 2 vols (8-10 ml) 8M HNO₃ --> Fe
Elute 4-5 vols 0.1M HCl --> U

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Source Preparation:

Thorium - OH⁻ precipitation onto filter

1. Evaporate solution containing Th to near dryness, add ~ 2 ml conc HNO₃ and evaporate to 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 4/5/95

Uranium - F⁻ precipitation onto filter

1. To the solution containing U, add 1 ml of 10% sodium hydrogen sulfate and 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 disappears 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 4/3/95

U/Th Digestion (Nopal rock samples)

Sample I. D. # NOPE-381

Date 2/13/95

Acid Digestion by Microwave: This method is useful for total decomposition of many different types of materials including rocks.

1. Consult CEM Microwave Sample Preparation Applications Manual for the microwave sample preparation note for the type of sample (e.g., Fe-oxides, tuff, etc...) to be dissolved. The application note discusses the amount of sample and reagents to be used, and program parameters to be entered for the microwave digestion.

Application Note = 054

2. Record dry weight of sample = .5060 g and place in a teflon PFA vessel.
3. Using a weighing boat, quantitatively add a known amount of $^{232}\text{U}/^{228}\text{Th}$ spike to the PFA vessel.

$^{232}\text{U}/^{228}\text{Th}$ spike # 25B
 ^{232}U

Reference Date 1/22/93

Reference Activity 204.88 pCi/g

Spike wt. .4990 g

3. Add reagents to vessel and record volumes:

Reagents	Volume (ml)
<u>HF</u>	<u>7</u>
<u>HCl</u>	<u>3</u>
<u>H₂O</u>	<u>1</u>

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.

Extraction:

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 ~10 mg 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.
10. Dissolve the precipitate in ~3 ml conc HCl. Add 1 ml ultrapure water to dilute to ~9M.

Column Separation:

Resin: BIO-RAD Anion Exchange Resin AG 1-X8 100-200 mesh chloride form.
(Lot # 45750A)

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 3/28/95

***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 HNO₃)

Heat Th fraction to evaporate HCl
Add ~5 ml conc HNO₃ to dissolve residue
Add equal vol (~5 ml) DI water so soln 8M HNO₃
Load onto column in 8M HNO₃
Wash 3-4 column vols 8M HNO₃
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 HNO₃)

Evaoprate U fraction to near dryness
Pick up in about 2 ml conc HNO₃
Dilute with about 2 ml DI water to approx 8M HNO₃
Load onto column in 8M HNO₃
Wash 2 vols (8-10 ml) 8M HNO₃ --> Fe
Elute 4-5 vols 0.1M HCl --> U

Source Preparation:

Thorium - OH⁻ precipitation onto filter

1. Evaporate solution containing Th to near dryness, add ~ 2 ml conc HNO₃ and evaporate to 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 4/5/95

Uranium - F⁻ precipitation onto filter

1. To the solution containing U, add 1 ml of 10% sodium hydrogen sulfate and 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 disappears 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 4/3/95

U/Th Digestion (Nopal rock samples)

Sample I. D. # NOPI-382

Date 2/13/95

Acid Digestion by Microwave: This method is useful for total decomposition of many different types of materials including rocks.

1. Consult CEM Microwave Sample Preparation Applications Manual for the microwave sample preparation note for the type of sample (e.g., Fe-oxides, tuff, etc...) to be dissolved. The application note discusses the amount of sample and reagents to be used, and program parameters to be entered for the microwave digestion.

Application Note = 05-4

2. Record dry weight of sample = .5078 g and place in a teflon PFA vessel.
3. Using a weighing boat, quantitatively add a known amount of $^{232}\text{U}/^{228}\text{Th}$ spike to the PFA vessel.

$^{232}\text{U}/^{228}\text{Th}$ spike # 25B

Reference Date 1/22/93

^{232}U Reference Activity 204.88 pCi/g

Spike wt. .4992 g

3. Add reagents to vessel and record volumes:

Reagents	Volume (ml)
<u>HF</u>	<u>7</u>
<u>HCl</u>	<u>3</u>
<u>HNO₃</u>	<u>1</u>

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.

Extraction:

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 ~10 mg 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.
10. Dissolve the precipitate in ~3 ml conc HCl. Add 1 ml ultrapure water to dilute to ~9M.

Column Separation:

Resin: BIO-RAD Anion Exchange Resin AG 1-X8 100-200 mesh chloride form.
(Lot # 49750A)

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 3/28/95

***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 HNO₃)

Heat Th fraction to evaporate HCl
Add ~5 ml conc HNO₃ to dissolve residue
Add equal vol (~5 ml) DI water so soln 8M HNO₃
Load onto column in 8M HNO₃
Wash 3-4 column vols 8M HNO₃
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 HNO₃)

Evaoprate U fraction to near dryness
Pick up in about 2 ml conc HNO₃
Dilute with about 2 ml DI water to approx 8M HNO₃
Load onto column in 8M HNO₃
Wash 2 vols (8-10 ml) 8M HNO₃ --> Fe
Elute 4-5 vols 0.1M HCl --> U

Source Preparation:

Thorium - OH⁻ precipitation onto filter

1. Evaporate solution containing Th to near dryness, add ~ 2 ml conc HNO₃ and evaporate to 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 4/6/95

Uranium - F⁻ precipitation onto filter

1. To the solution containing U, add 1 ml of 10% sodium hydrogen sulfate and 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 disappears 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 4/3/95

U/Th Digestion (Nopal rock samples)

Sample I. D. # NOPI-383

Date 2/13/95

Acid Digestion by Microwave: This method is useful for total decomposition of many different types of materials including rocks.

1. Consult CEM Microwave Sample Preparation Applications Manual for the microwave sample preparation note for the type of sample (e.g., Fe-oxides, tuff, etc...) to be dissolved. The application note discusses the amount of sample and reagents to be used, and program parameters to be entered for the microwave digestion.

Application Note = 034

2. Record dry weight of sample = .5059 g and place in a teflon PFA vessel.
3. Using a weighing boat, quantitatively add a known amount of $^{232}\text{U}/^{228}\text{Th}$ spike to the PFA vessel.

$^{232}\text{U}/^{228}\text{Th}$ spike # 25B
 ^{232}U
 Reference Activity 204.88 pCi/g

Reference Date 1/22/93
 Spike wt. .4985 g

3. Add reagents to vessel and record volumes:

Reagents	Volume (ml)
<u>HF</u>	<u>7</u>
<u>HCl</u>	<u>3</u>
<u>HNO₃</u>	<u>1</u>

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.

Extraction:

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 ~10 mg 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 scavenge by centrifugation and decant. Wash the precipitate with ultrapure water, centrifuge, and decant. Repeat washing.
10. Dissolve the precipitate in ~3 ml conc HCl. Add 1 ml ultrapure water to dilute to ~9M.

Column Separation:

Resin: BIO-RAD Anion Exchange Resin AG 1-X8 100-200 mesh chloride form.
(Lot # 49750A)

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 3/28/95

***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 HNO₃)

Heat Th fraction to evaporate HCl
Add ~5 ml conc HNO₃ to dissolve residue
Add equal vol (~5 ml) DI water so soln 8M HNO₃
Load onto column in 8M HNO₃
Wash 3-4 column vols 8M HNO₃
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 HNO₃)

Evaporate U fraction to near dryness
Pick up in about 2 ml conc HNO₃
Dilute with about 2 ml DI water to approx 8M HNO₃
Load onto column in 8M HNO₃
Wash 2 vols (8-10 ml) 8M HNO₃ --> Fe
Elute 4-5 vols 0.1M HCl --> U

Source Preparation:

Thorium - OH⁻ precipitation onto filter

1. Evaporate solution containing Th to near dryness, add ~ 2 ml conc HNO₃ and evaporate to 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 4/6/95

Uranium - F⁻ precipitation onto filter

1. To the solution containing U, add 1 ml of 10% sodium hydrogen sulfate and 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 disappears 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 4/3/95

U/Th Digestion (Nopal rock samples)

Sample I. D. # NOPI-384

Date 2/13/95

Acid Digestion by Microwave: This method is useful for total decomposition of many different types of materials including rocks.

1. Consult CEM Microwave Sample Preparation Applications Manual for the microwave sample preparation note for the type of sample (e.g., Fe-oxides, tuff, etc...) to be dissolved. The application note discusses the amount of sample and reagents to be used, and program parameters to be entered for the microwave digestion.

Application Note = 054

2. Record dry weight of sample = .5105 g and place in a teflon PFA vessel.
3. Using a weighing boat, quantitatively add a known amount of $^{232}\text{U}/^{228}\text{Th}$ spike to the PFA vessel.

$^{232}\text{U}/^{228}\text{Th}$ spike # 2513
 _{^{232}U}

Reference Date 1/22/93

Reference Activity 204.88 pCi/g

Spike wt. .4981 g

3. Add reagents to vessel and record volumes:

Reagents	Volume (ml)
<u>HF</u>	<u>7</u>
<u>HCl</u>	<u>3</u>
<u>HNO₃</u>	<u>1</u>

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.

Extraction:

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 ~10 mg 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.
10. Dissolve the precipitate in ~3 ml conc HCl. Add 1 ml ultrapure water to dilute to ~9M.

Column Separation:

Resin: BIO-RAD Anion Exchange Resin AG 1-X8 100-200 mesh chloride form.
(Lot # 49750A)

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 3/28/95

***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 HNO₃)

Heat Th fraction to evaporate HCl —
Add ~5 ml conc HNO₃ to dissolve residue —
Add equal vol (~5 ml) DI water so soln 8M HNO₃ —
Load onto column in 8M HNO₃ —
Wash 3-4 column vols 8M HNO₃ — —
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 HNO₃)

Evaoprate U fraction to near dryness —
Pick up in about 2 ml conc HNO₃ —
Dilute with about 2 ml DI water to approx 8M HNO₃ —
Load onto column in 8M HNO₃ —
Wash 2 vols (8-10 ml) 8M HNO₃ --> Fe — —
Elute 4-5 vols 0.1M HCl --> U — — —

Source Preparation:

Thorium - OH⁻ precipitation onto filter

1. Evaporate solution containing Th to near dryness, add ~ 2 ml conc HNO₃ and evaporate to 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

4/7/95

Uranium - F⁻ precipitation onto filter

1. To the solution containing U, add 1 ml of 10% sodium hydrogen sulfate and 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 disappears 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

4/4/95

U/Th Digestion (Nopal rock samples)

Sample I. D. # NOPI-385

Date 2/13/95

Acid Digestion by Microwave: This method is useful for total decomposition of many different types of materials including rocks.

1. Consult CEM Microwave Sample Preparation Applications Manual for the microwave sample preparation note for the type of sample (e.g., Fe-oxides, tuff, etc...) to be dissolved. The application note discusses the amount of sample and reagents to be used, and program parameters to be entered for the microwave digestion.

Application Note = 054

2. Record dry weight of sample = .5112 g and place in a teflon PFA vessel.
3. Using a weighing boat, quantitatively add a known amount of $^{232}\text{U}/^{228}\text{Th}$ spike to the PFA vessel.

$^{232}\text{U}/^{228}\text{Th}$ spike # 25 B
 ^{232}U
 Reference Activity 204.88 pCi/g

Reference Date 1/22/93
 Spike wt. .5060 g

3. Add reagents to vessel and record volumes:

Reagents	Volume (ml)
<u>HF</u>	<u>7</u>
<u>HCl</u>	<u>3</u>
<u>H₂O₂</u>	<u>1</u>

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.

Extraction:

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 ~10 mg 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.
10. Dissolve the precipitate in ~3 ml conc HCl. Add 1 ml ultrapure water to dilute to ~9M.

Column Separation:

Resin: BIO-RAD Anion Exchange Resin AG 1-X8 100-200 mesh chloride form.
(Lot # 49750A)

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

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Separation Date 3/28/95

***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 HNO₃)

Heat Th fraction to evaporate HCl
Add ~5 ml conc HNO₃ to dissolve residue
Add equal vol (~5 ml) DI water so soln 8M HNO₃
Load onto column in 8M HNO₃
Wash 3-4 column vols 8M HNO₃
Elute 4-5 column vols 9M HCl --> Th

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Uranium Column (Biorad 0.7 cm diameter column with 10 cm resin; prewash with 4-5 column vols 8M HNO₃)

Evaporate U fraction to near dryness
Pick up in about 2 ml conc HNO₃
Dilute with about 2 ml DI water to approx 8M HNO₃
Load onto column in 8M HNO₃
Wash 2 vols (8-10 ml) 8M HNO₃ --> Fe
Elute 4-5 vols 0.1M HCl --> U

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Source Preparation:

Thorium - OH⁻ precipitation onto filter

1. Evaporate solution containing Th to near dryness, add ~ 2 ml conc HNO₃ and evaporate to 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

4/7/95

Uranium - F⁻ precipitation onto filter

1. To the solution containing U, add 1 ml of 10% sodium hydrogen sulfate and 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 disappears 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

4/4/95

U/Th Digestion (Nopal rock samples)

Sample I. D. # NOPI-386

Date 2/13/95

Acid Digestion by Microwave: This method is useful for total decomposition of many different types of materials including rocks.

1. Consult CEM Microwave Sample Preparation Applications Manual for the microwave sample preparation note for the type of sample (e.g., Fe-oxides, tuff, etc...) to be dissolved. The application note discusses the amount of sample and reagents to be used, and program parameters to be entered for the microwave digestion.

Application Note = 054

2. Record dry weight of sample = .5057 g and place in a teflon PFA vessel.
3. Using a weighing boat, quantitatively add a known amount of $^{232}\text{U}/^{228}\text{Th}$ spike to the PFA vessel.

$^{232}\text{U}/^{228}\text{Th}$ spike # 253

Reference Date 1/22/93

^{232}U
Reference Activity 204.88 pCi/g

Spike wt. .5002 g

3. Add reagents to vessel and record volumes:

Reagents	Volume (ml)
<u>HF</u>	<u>7</u>
<u>HCl</u>	<u>3</u>
<u>H₂O₂</u>	<u>1</u>

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.

Extraction:

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 ~10 mg 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 scavenge by centrifugation and decant. Wash the precipitate with ultrapure water, centrifuge, and decant. Repeat washing.
10. Dissolve the precipitate in ~3 ml conc HCl. Add 1 ml ultrapure water to dilute to ~9M.

Column Separation:

Resin: BIO-RAD Anion Exchange Resin AG 1-X8 100-200 mesh chloride form.
(Lot # 49750A)

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 3/28/95

***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 HNO₃)

Heat Th fraction to evaporate HCl
Add ~5 ml conc HNO₃ to dissolve residue
Add equal vol (~5 ml) DI water so soln 8M HNO₃
Load onto column in 8M HNO₃
Wash 3-4 column vols 8M HNO₃
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 HNO₃)

Evaporate U fraction to near dryness
Pick up in about 2 ml conc HNO₃
Dilute with about 2 ml DI water to approx 8M HNO₃
Load onto column in 8M HNO₃
Wash 2 vols (8-10 ml) 8M HNO₃ --> Fe
Elute 4-5 vols 0.1M HCl --> U

Source Preparation:

Thorium - OH⁻ precipitation onto filter

1. Evaporate solution containing Th to near dryness, add ~ 2 ml conc HNO₃ and evaporate to 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 4/10/95

Uranium - F⁻ precipitation onto filter

1. To the solution containing U, add 1 ml of 10% sodium hydrogen sulfate and 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 disappears 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 4/4/95

U/Th Digestion (Nopal rock samples)

Sample I. D. # NOPE-387

Date 2/13/95

Acid Digestion by Microwave: This method is useful for total decomposition of many different types of materials including rocks.

1. Consult CEM Microwave Sample Preparation Applications Manual for the microwave sample preparation note for the type of sample (e.g., Fe-oxides, tuff, etc...) to be dissolved. The application note discusses the amount of sample and reagents to be used, and program parameters to be entered for the microwave digestion.

Application Note = OS-4

2. Record dry weight of sample = .5098 g and place in a teflon PFA vessel.
3. Using a weighing boat, quantitatively add a known amount of ²³²U/²²⁸Th spike to the PFA vessel.

²³²U/²²⁸Th spike # 25B
²³²U
 Reference Activity 204.88 pCi/g

Reference Date 1/22/93
 Spike wt. .5021 g

3. Add reagents to vessel and record volumes:

Reagents	Volume (ml)
<u>HF</u>	<u>7</u>
<u>HCl</u>	<u>3</u>
<u>H₂O</u>	<u>1</u>

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.

Extraction:

7. Add 1 ml of perchloric acid (HClO₄) to the sample solution in the teflon beaker. Evaporate to fumes of HClO₄. 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 ~10 mg Fe carrier and coprecipitate actinides by addition of NH₄OH 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.
10. Dissolve the precipitate in ~3 ml conc HCl. Add 1 ml ultrapure water to dilute to ~9M.

Column Separation:

Resin: BIO-RAD Anion Exchange Resin AG 1-X8 100-200 mesh chloride form.
(Lot # 49750A)

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 3/28/95

***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 HNO₃)

Heat Th fraction to evaporate HCl
Add ~5 ml conc HNO₃ to dissolve residue
Add equal vol (~5 ml) DI water so soln 8M HNO₃
Load onto column in 8M HNO₃
Wash 3-4 column vols 8M HNO₃
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 HNO₃)

Evaoprate U fraction to near dryness
Pick up in about 2 ml conc HNO₃
Dilute with about 2 ml DI water to approx 8M HNO₃
Load onto column in 8M HNO₃
Wash 2 vols (8-10 ml) 8M HNO₃ --> Fe
Elute 4-5 vols 0.1M HCl --> U

Source Preparation:

Thorium - OH⁻ precipitation onto filter

1. Evaporate solution containing Th to near dryness, add ~ 2 ml conc HNO₃ and evaporate to 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 4/10/95

Uranium - F⁻ precipitation onto filter

1. To the solution containing U, add 1 ml of 10% sodium hydrogen sulfate and 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 disappears 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 4/4/95

U/Th Digestion (Nopal rock samples)

Sample I. D. # NOP I - 388

Date 2/13/95

Acid Digestion by Microwave: This method is useful for total decomposition of many different types of materials including rocks.

1. Consult CEM Microwave Sample Preparation Applications Manual for the microwave sample preparation note for the type of sample (e.g., Fe-oxides, tuff, etc...) to be dissolved. The application note discusses the amount of sample and reagents to be used, and program parameters to be entered for the microwave digestion.

Application Note = DS 4

2. Record dry weight of sample = .5056 g and place in a teflon PFA vessel.
3. Using a weighing boat, quantitatively add a known amount of $^{232}\text{U}/^{228}\text{Th}$ spike to the PFA vessel.

$^{232}\text{U}/^{228}\text{Th}$ spike # 25 B
Reference Activity 204.88 pCi/g

Reference Date 1/22/93
Spike wt. .5029 g

3. Add reagents to vessel and record volumes:

Reagents	Volume (ml)
<u>HF</u>	<u>7</u>
<u>HCl</u>	<u>3</u>
<u>H₂O₂</u>	<u>1</u>

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.

Extraction:

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 ~10 mg 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.
10. Dissolve the precipitate in ~3 ml conc HCl. Add 1 ml ultrapure water to dilute to ~9M.

Column Separation:

Resin: BIO-RAD Anion Exchange Resin AG 1-X8 100-200 mesh chloride form.
(Lot # 49750A)

Main Column (Biorad 1.5 cm diameter column with 10 cm resin; prewash with 4-5 column voils 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

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Separation Date 3/27/95

***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 voils 8M HNO₃)

Heat Th fraction to evaporate HCl
Add ~5 ml conc HNO₃ to dissolve residue
Add equal vol (~5 ml) DI water so soln 8M HNO₃
Load onto column in 8M HNO₃
Wash 3-4 column voils 8M HNO₃
Elute 4-5 column voils 9M HCl --> Th

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Uranium Column (Biorad 0.7 cm diameter column with 10 cm resin; prewash with 4-5 column voils 8M HNO₃)

Evaoprte U fraction to near dryness
Pick up in about 2 ml conc HNO₃
Dilute with about 2 ml DI water to approx 8M HNO₃
Load onto column in 8M HNO₃
Wash 2 voils (8-10 ml) 8M HNO₃ --> Fe
Elute 4-5 voils 0.1M HCl --> U

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Source Preparation:

Thorium - OH⁻ precipitation onto filter

1. Evaporate solution containing Th to near dryness, add ~ 2 ml conc HNO₃ and evaporate to 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

4/11/95

Uranium - F⁻ precipitation onto filter

1. To the solution containing U, add 1 ml of 10% sodium hydrogen sulfate and 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 disappears 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

4/4/95

U/Th Digestion (Nopal rock samples)

Sample I. D. # NOPI-389

Date 2/13/95

Acid Digestion by Microwave: This method is useful for total decomposition of many different types of materials including rocks.

1. Consult CEM Microwave Sample Preparation Applications Manual for the microwave sample preparation note for the type of sample (e.g., Fe-oxides, tuff, etc...) to be dissolved. The application note discusses the amount of sample and reagents to be used, and program parameters to be entered for the microwave digestion.

Application Note = 054

2. Record dry weight of sample = .5056 g and place in a teflon PFA vessel.
3. Using a weighing boat, quantitatively add a known amount of ²³²U/²²⁸Th spike to the PFA vessel.

²³²U/²²⁸Th spike # 25 B
232U
Reference Activity 204.88 pCi/g

Reference Date 1/22/93
Spike wt. .5016 g

3. Add reagents to vessel and record volumes:

Reagents	Volume (ml)
<u>HF</u>	<u>2</u>
<u>HCl</u>	<u>3</u>
<u>HNO₃</u>	<u>1</u>
<u>3</u>	

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.

Extraction:

7. Add 1 ml of perchloric acid (HClO₄) to the sample solution in the teflon beaker. Evaporate to fumes of HClO₄. 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 ~10 mg Fe carrier and coprecipitate actinides by addition of NH₄OH to pH = 7.
****Note:** if sample already contains significant Fe, then Fe carrier does not need to be added.
9. Separate the Fe scavenge by centrifugation and decant. Wash the precipitate with ultrapure water, centrifuge, and decant. Repeat washing.
10. Dissolve the precipitate in ~3 ml conc HCl. Add 1 ml ultrapure water to dilute to ~9M.

Column Separation:

Resin: BIO-RAD Anion Exchange Resin AG 1-X8 100-200 mesh chloride form.
(Lot # 49-750 A)

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

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Separation Date 3/27/95

***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 HNO₃)

Heat Th fraction to evaporate HCl
Add ~5 ml conc HNO₃ to dissolve residue
Add equal vol (~5 ml) DI water so soln 8M HNO₃
Load onto column in 8M HNO₃
Wash 3-4 column vols 8M HNO₃
Elute 4-5 column vols 9M HCl --> Th

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Uranium Column (Biorad 0.7 cm diameter column with 10 cm resin; prewash with 4-5 column vols 8M HNO₃)

Evaporate U fraction to near dryness
Pick up in about 2 ml conc HNO₃
Dilute with about 2 ml DI water to approx 8M HNO₃
Load onto column in 8M HNO₃
Wash 2 vols (8-10 ml) 8M HNO₃ --> Fe
Elute 4-5 vols 0.1M HCl --> U

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Source Preparation:

Thorium - OH⁻ precipitation onto filter

1. Evaporate solution containing Th to near dryness, add ~ 2 ml conc HNO₃ and evaporate to 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 4/11/95

Uranium - F⁻ precipitation onto filter

1. To the solution containing U, add 1 ml of 10% sodium hydrogen sulfate and 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 disappears 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 4/4/95

U/Th Digestion (Nopal rock samples)

Sample I. D. # NOPI-390

Date 2/22/95

Acid Digestion by Microwave: This method is useful for total decomposition of many different types of materials including rocks.

1. Consult CEM Microwave Sample Preparation Applications Manual for the microwave sample preparation note for the type of sample (e.g., Fe-oxides, tuff, etc...) to be dissolved. The application note discusses the amount of sample and reagents to be used, and program parameters to be entered for the microwave digestion.

Application Note = 054.

2. Record dry weight of sample = .5042 g and place in a teflon PFA vessel.
3. Using a weighing boat, quantitatively add a known amount of $^{232}\text{U}/^{228}\text{Th}$ spike to the PFA vessel.

$^{232}\text{U}/^{228}\text{Th}$ spike # 253
232u

Reference Date 1/22/93

Reference Activity 204.88 pCi/g

Spike wt. .5017 g

3. Add reagents to vessel and record volumes:

Reagents	Volume (ml)
<u>HF</u>	<u>7</u>
<u>HCl</u>	<u>3</u>
<u>HNO₃</u>	<u>1</u>

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.

Extraction:

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 ~10 mg 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 scavage by centrifugation and decant. Wash the precipitate with ultrapure water, centrifuge, and decant. Repeat washing.
10. Dissolve the precipitate in ~3 ml conc HCl. Add 1 ml ultrapure water to dilute to ~9M.

Column Separation:

Resin: BIO-RAD Anion Exchange Resin AG 1-X8 100-200 mesh chloride form.
(Lot # 49750A)

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

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Separation Date 3/27/95

***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 HNO₃)

Heat Th fraction to evaporate HCl
Add ~5 ml conc HNO₃ to dissolve residue
Add equal vol (~5 ml) DI water so soln 8M HNO₃
Load onto column in 8M HNO₃
Wash 3-4 column vols 8M HNO₃
Elute 4-5 column vols 9M HCl --> Th

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Uranium Column (Biorad 0.7 cm diameter column with 10 cm resin; prewash with 4-5 column vols 8M HNO₃)

Evaoprate U fraction to near dryness
Pick up in about 2 ml conc HNO₃
Dilute with about 2 ml DI water to approx 8M HNO₃
Load onto column in 8M HNO₃
Wash 2 vols (8-10 ml) 8M HNO₃ --> Fe
Elute 4-5 vols 0.1M HCl --> U

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Source Preparation:

Thorium - OH⁻ precipitation onto filter

1. Evaporate solution containing Th to near dryness, add ~ 2 ml conc HNO₃ and evaporate to 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

4/12/95

Uranium - F⁻ precipitation onto filter

1. To the solution containing U, add 1 ml of 10% sodium hydrogen sulfate and 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 disappears 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

4/4/95

U/Th Digestion (Nopal rock samples)

Sample I. D. # NOPI-391

Date 2/22/95

Acid Digestion by Microwave: This method is useful for total decomposition of many different types of materials including rocks.

1. Consult CEM Microwave Sample Preparation Applications Manual for the microwave sample preparation note for the type of sample (e.g., Fe-oxides, tuff, etc...) to be dissolved. The application note discusses the amount of sample and reagents to be used, and program parameters to be entered for the microwave digestion.

Application Note = 054

2. Record dry weight of sample = .5054 g and place in a teflon PFA vessel.
3. Using a weighing boat, quantitatively add a known amount of $^{232}\text{U}/^{228}\text{Th}$ spike to the PFA vessel.

$^{232}\text{U}/^{228}\text{Th}$ spike # 25B

Reference Date 1/22/93

^{232}U
Reference Activity 204.88 pCi/g

Spike wt. .5042 g

3. Add reagents to vessel and record volumes:

Reagents	Volume (ml)
<u>HF</u>	<u>7</u>
<u>HCl</u>	<u>3</u>
<u>HNO₃</u>	<u>1</u>

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.

Extraction:

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 ~10 mg 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.
10. Dissolve the precipitate in ~3 ml conc HCl. Add 1 ml ultrapure water to dilute to ~9M.

Column Separation:

Resin: BIO-RAD Anion Exchange Resin AG 1-X8 100-200 mesh chloride form.
(Lot # 49750A)

Main Column (Biorad 1.5 cm diameter column with 10 cm resin; prewash with 4-5 column voils 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 3/27/95

***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 voils 8M HNO₃)

Heat Th fraction to evaporate HCl —
Add ~5 ml conc HNO₃ to dissolve residue —
Add equal vol (~5 ml) DI water so soln 8M HNO₃ —
Load onto column in 8M HNO₃ —
Wash 3-4 column voils 8M HNO₃ — — —
Elute 4-5 column voils 9M HCl --> Th — — — —

Uranium Column (Biorad 0.7 cm diameter column with 10 cm resin; prewash with 4-5 column voils 8M HNO₃)

Evaoprate U fraction to near dryness —
Pick up in about 2 ml conc HNO₃ —
Dilute with about 2 ml DI water to approx 8M HNO₃ —
Load onto column in 8M HNO₃ —
Wash 2 voils (8-10 ml) 8M HNO₃ --> Fe — — —
Elute 4-5 voils 0.1M HCl --> U — — — —

Source Preparation:

Thorium - OH⁻ precipitation onto filter

1. Evaporate solution containing Th to near dryness, add ~ 2 ml conc HNO₃ and evaporate to 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 4/12/95

Uranium - F⁻ precipitation onto filter

1. To the solution containing U, add 1 ml of 10% sodium hydrogen sulfate and 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 disappears 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 4/4/95

U/Th Digestion (Nopal rock samples)

Sample I. D. # NOPI-399

Date 2/22/95

Acid Digestion by Microwave: This method is useful for total decomposition of many different types of materials including rocks.

1. Consult CEM Microwave Sample Preparation Applications Manual for the microwave sample preparation note for the type of sample (e.g., Fe-oxides, tuff, etc...) to be dissolved. The application note discusses the amount of sample and reagents to be used, and program parameters to be entered for the microwave digestion.

Application Note = 05-4

2. Record dry weight of sample = .5100 g and place in a teflon PFA vessel.
3. Using a weighing boat, quantitatively add a known amount of $^{232}\text{U}/^{228}\text{Th}$ spike to the PFA vessel.

$^{232}\text{U}/^{228}\text{Th}$ spike # 253
222u

Reference Date 1/22/93

Reference Activity 204.88 pCi/g

Spike wt. .5051 g

3. Add reagents to vessel and record volumes:

Reagents	Volume (ml)
<u>HF</u>	<u>7</u>
<u>HCl</u>	<u>3</u>
<u>H₂O</u>	<u>1</u>

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.

Extraction:

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 ~10 mg 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.
10. Dissolve the precipitate in ~3 ml conc HCl. Add 1 ml ultrapure water to dilute to ~9M.

Column Separation:

Resin: BIO-RAD Anion Exchange Resin AG 1-X8 100-200 mesh chloride form.
(Lot # 49750A)

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 3/27/95

***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 HNO₃)

Heat Th fraction to evaporate HCl —
Add ~5 ml conc HNO₃ to dissolve residue —
Add equal vol (~5 ml) DI water so soln 8M HNO₃ —
Load onto column in 8M HNO₃ —
Wash 3-4 column vols 8M HNO₃ — — —
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 HNO₃)

Evaoprate U fraction to near dryness —
Pick up in about 2 ml conc HNO₃ —
Dilute with about 2 ml DI water to approx 8M HNO₃ —
Load onto column in 8M HNO₃ —
Wash 2 vols (8-10 ml) 8M HNO₃ --> Fe — —
Elute 4-5 vols 0.1M HCl --> U — — — —

Source Preparation:

Thorium - OH⁻ precipitation onto filter

1. Evaporate solution containing Th to near dryness, add ~ 2 ml conc HNO₃ and evaporate to 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 4/4/95

Uranium - F⁻ precipitation onto filter

1. To the solution containing U, add 1 ml of 10% sodium hydrogen sulfate and 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 disappears 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 4/3/95

U/Th Digestion (Nopal rock samples)

Sample I. D. # NOPI-400

Date 2/22/95

Acid Digestion by Microwave: This method is useful for total decomposition of many different types of materials including rocks.

1. Consult CEM Microwave Sample Preparation Applications Manual for the microwave sample preparation note for the type of sample (e.g., Fe-oxides, tuff, etc...) to be dissolved. The application note discusses the amount of sample and reagents to be used, and program parameters to be entered for the microwave digestion.

Application Note = 094

2. Record dry weight of sample = .5021 g and place in a teflon PFA vessel.
3. Using a weighing boat, quantitatively add a known amount of $^{232}\text{U}/^{228}\text{Th}$ spike to the PFA vessel.

$^{232}\text{U}/^{228}\text{Th}$ spike # 25B
232U

Reference Date 1/22/93

Reference Activity 204.88 pCi/g

Spike wt. .5053 g

3. Add reagents to vessel and record volumes:

Reagents	Volume (ml)
<u>HF</u>	<u>7</u>
<u>HCl</u>	<u>3</u>
<u>HNO₃</u>	<u>1</u>

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.

Extraction:

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 ~10 mg 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.
10. Dissolve the precipitate in ~3 ml conc HCl. Add 1 ml ultrapure water to dilute to ~9M.

Column Separation:

Resin: BIO-RAD Anion Exchange Resin AG 1-X8 100-200 mesh chloride form.
(Lot # 49750A)

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

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— — —
— — — —

Separation Date 3/27/95

***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 HNO₃)

Heat Th fraction to evaporate HCl
Add ~5 ml conc HNO₃ to dissolve residue
Add equal vol (~5 ml) DI water so soln 8M HNO₃
Load onto column in 8M HNO₃
Wash 3-4 column vols 8M HNO₃
Elute 4-5 column vols 9M HCl --> Th

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— — — —
— — — —

Uranium Column (Biorad 0.7 cm diameter column with 10 cm resin; prewash with 4-5 column vols 8M HNO₃)

Evaoprate U fraction to near dryness
Pick up in about 2 ml conc HNO₃
Dilute with about 2 ml DI water to approx 8M HNO₃
Load onto column in 8M HNO₃
Wash 2 vols (8-10 ml) 8M HNO₃ --> Fe
Elute 4-5 vols 0.1M HCl --> U

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— — — —
— — — —

Source Preparation:

Thorium - OH⁻ precipitation onto filter

1. Evaporate solution containing Th to near dryness, add ~ 2 ml conc HNO₃ and evaporate to 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 4/4/95

Uranium - F⁻ precipitation onto filter

1. To the solution containing U, add 1 ml of 10% sodium hydrogen sulfate and 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 disappears 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 4/3/95

U/Th Digestion (Nopal rock samples)

Sample I. D. # NOPI-494-SEPI

Date 10/10/95

Acid Digestion by Microwave: This method is useful for total decomposition of many different types of materials including rocks.

1. Consult CEM Microwave Sample Preparation Applications Manual for the microwave sample preparation note for the type of sample (e.g., Fe-oxides, tuff, etc...) to be dissolved. The application note discusses the amount of sample and reagents to be used, and program parameters to be entered for the microwave digestion.

Application Note = _____.

2. Record dry weight of sample = .0705 g and place in a teflon PFA vessel.
3. Using a weighing boat, quantitatively add a known amount of $^{232}\text{U}/^{228}\text{Th}$ spike to the PFA vessel.

$^{232}\text{U}/^{228}\text{Th}$ spike # 25B

Reference Date 1/22/93

Reference Activity ^{232}U 204.88 pCi/g

Spike wt. .9161 g

3. Add reagents to vessel and record volumes:

Reagents	Volume (ml)
<u>0.1M HClO₄</u>	<u>100</u>
<u>8N HNO₃</u>	<u>2</u>
<u>HF</u>	<u>1</u>
_____	_____

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.

Extraction:

7. Add 1 ml of perchloric acid (HClO₄) to the sample solution in the teflon beaker. Evaporate to fumes of HClO₄. 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 ~10 mg Fe carrier and coprecipitate actinides by addition of NH₄OH to pH = 7.
**Note: if sample already contains significant Fe, then Fe carrier does not need to be added.
9. Separate the Fe scavenge by centrifugation and decant. Wash the precipitate with ultrapure water, centrifuge, and decant. Repeat washing.
10. Dissolve the precipitate in ~3 ml conc HCl. Add 1 ml ultrapure water to dilute to ~9M.

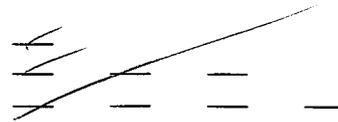
Column Separation:

Resin: BIO-RAD Anion Exchange Resin AG 1-X8 100-200 mesh chloride form.

(Lot # 49758A)

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

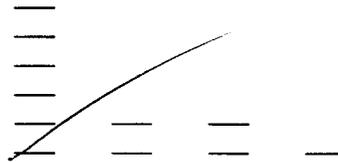


Separation Date 10/11/95

***Note: May work on U and Th fractions simultaneously from this point on.

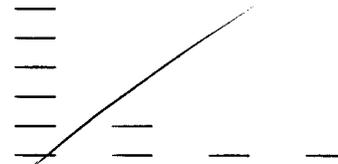
Thorium Column (Biorad 0.7 cm diameter column with 10 cm resin; prewash with 4-5 column vols 8M HNO₃)

Heat Th fraction to evaporate HCl
Add ~5 ml conc HNO₃ to dissolve residue
Add equal vol (~5 ml) DI water so soln 8M HNO₃
Load onto column in 8M HNO₃
Wash 3-4 column vols 8M HNO₃
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 HNO₃)

Evaoprate U fraction to near dryness
Pick up in about 2 ml conc HNO₃
Dilute with about 2 ml DI water to approx 8M HNO₃
Load onto column in 8M HNO₃
Wash 2 vols (8-10 ml) 8M HNO₃ --> Fe
Elute 4-5 vols 0.1M HCl --> U



Source Preparation:

Thorium - OH⁻ precipitation onto filter

1. Evaporate solution containing Th to near dryness, add ~ 2 ml conc HNO₃ and evaporate to 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 10/13/95

Uranium - F⁻ precipitation onto filter

1. To the solution containing U, add 1 ml of 10% sodium hydrogen sulfate and 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 disappears 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 10/13/95

U/Th Digestion (Nopal rock samples)

Sample I. D. # WOP1-494-SEP2

Date 10/10/95

Acid Digestion by Microwave: This method is useful for total decomposition of many different types of materials including rocks.

1. Consult CEM Microwave Sample Preparation Applications Manual for the microwave sample preparation note for the type of sample (e.g., Fe-oxides, tuff, etc...) to be dissolved. The application note discusses the amount of sample and reagents to be used, and program parameters to be entered for the microwave digestion.

Application Note = _____.

2. Record dry weight of sample = .0489 g and place in a teflon PFA vessel.
3. Using a weighing boat, quantitatively add a known amount of $^{232}\text{U}/^{228}\text{Th}$ spike to the PFA vessel.

$^{232}\text{U}/^{228}\text{Th}$ spike # 25B

Reference Date 1/22/93

Reference Activity 204.88 pCi/g

Spike wt. .9087 g

3. Add reagents to vessel and record volumes:

Reagents	Volume (ml)
<u>0.1M HClO₄</u>	<u>100</u>
<u>8N HNO₃</u>	<u>2</u>
<u>HF</u>	<u>1</u>

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.

Extraction:

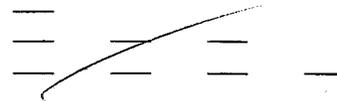
7. Add 1 ml of perchloric acid (HClO₄) to the sample solution in the teflon beaker. Evaporate to fumes of HClO₄. Pick up in a small amount (~2 ml) of conc. HCl and dilute to approximately 2M (total ~10 ml).
 8. Transfer solution to a 50 ml PP centrifuge tube. Add ~10 mg Fe carrier and coprecipitate actinides by addition of NH₄OH 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.
 10. Dissolve the precipitate in ~3 ml conc HCl. Add 1 ml ultrapure water to dilute to ~9M.
-

Column Separation:

Resin: BIO-RAD Anion Exchange Resin AG 1-X8 100-200 mesh chloride form.
(Lot # 49750A)

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 10/11/95

***Note: May work on U and Th fractions simultaneously from this point on.

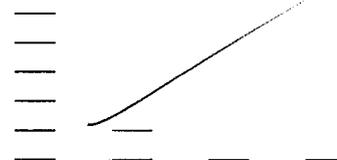
Thorium Column (Biorad 0.7 cm diameter column with 10 cm resin; prewash with 4-5 column vols 8M HNO₃)

Heat Th fraction to evaporate HCl
Add ~5 ml conc HNO₃ to dissolve residue
Add equal vol (~5 ml) DI water so soln 8M HNO₃
Load onto column in 8M HNO₃
Wash 3-4 column vols 8M HNO₃
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 HNO₃)

Evaoprate U fraction to near dryness
Pick up in about 2 ml conc HNO₃
Dilute with about 2 ml DI water to approx 8M HNO₃
Load onto column in 8M HNO₃
Wash 2 vols (8-10 ml) 8M HNO₃ --> Fe
Elute 4-5 vols 0.1M HCl --> U



Source Preparation:

Thorium - OH⁻ precipitation onto filter

1. Evaporate solution containing Th to near dryness, add ~ 2 ml conc HNO₃ and evaporate to 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 10/13/95

Uranium - F⁻ precipitation onto filter

1. To the solution containing U, add 1 ml of 10% sodium hydrogen sulfate and 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 disappears 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 10/13/95

U/Th Digestion (Nopal rock samples)

Sample I. D. # NOPI-494-SEP-SEP3

Date 10/10/95

Acid Digestion by Microwave: This method is useful for total decomposition of many different types of materials including rocks.

1. Consult CEM Microwave Sample Preparation Applications Manual for the microwave sample preparation note for the type of sample (e.g., Fe-oxides, tuff, etc...) to be dissolved. The application note discusses the amount of sample and reagents to be used, and program parameters to be entered for the microwave digestion.

Application Note = _____.

2. Record dry weight of sample = .0353 g and place in a teflon PFA vessel.
3. Using a weighing boat, quantitatively add a known amount of $^{232}\text{U}/^{228}\text{Th}$ spike to the PFA vessel.

$^{232}\text{U}/^{228}\text{Th}$ spike # 25 B

Reference Date 1/22/93

Reference Activity 204.88 pCi/g

Spike wt. .9088 g

3. Add reagents to vessel and record volumes:

Reagents	Volume (ml)
<u>0.1M HClO₄</u>	<u>100</u>
<u>8N HNO₃</u>	<u>2</u>
<u>HF</u>	<u>1</u>

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.

Extraction:

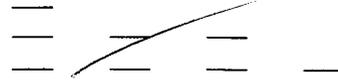
7. Add 1 ml of perchloric acid (HClO₄) to the sample solution in the teflon beaker. Evaporate to fumes of HClO₄. Pick up in a small amount (~2 ml) of conc. HCl and dilute to approximately 2M (total ~10 ml).
8. Transfer solution to a 50 ml PP centrifuge tube. Add ~10 mg Fe carrier and coprecipitate actinides by addition of NH₄OH 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.
10. Dissolve the precipitate in ~3 ml conc HCl. Add 1 ml ultrapure water to dilute to ~9M.

Column Separation:

Resin: BIO-RAD Anion Exchange Resin AG 1-X8 100-200 mesh chloride form.
(Lot # 44750A)

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

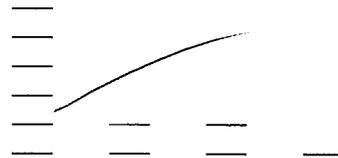


Separation Date 10/11/95

***Note: May work on U and Th fractions simultaneously from this point on.

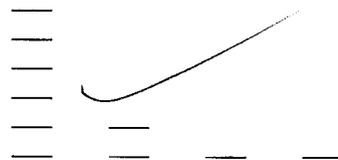
Thorium Column (Biorad 0.7 cm diameter column with 10 cm resin; prewash with 4-5 column vols 8M HNO₃)

Heat Th fraction to evaporate HCl
Add ~5 ml conc HNO₃ to dissolve residue
Add equal vol (~5 ml) DI water so soln 8M HNO₃
Load onto column in 8M HNO₃
Wash 3-4 column vols 8M HNO₃
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 HNO₃)

Evaoprate U fraction to near dryness
Pick up in about 2 ml conc HNO₃
Dilute with about 2 ml DI water to approx 8M HNO₃
Load onto column in 8M HNO₃
Wash 2 vols (8-10 ml) 8M HNO₃ --> Fe
Elute 4-5 vols 0.1M HCl --> U



Source Preparation:

Thorium - OH⁻ precipitation onto filter

1. Evaporate solution containing Th to near dryness, add ~ 2 ml conc HNO₃ and evaporate to 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 10/13/95

Uranium - F⁻ precipitation onto filter

1. To the solution containing U, add 1 ml of 10% sodium hydrogen sulfate and 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 disappears 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 10/13/95

U/Th Digestion (Nopal rock samples)

Sample I. D. # NOPI-417-PWD

Date 12/11/95

Acid Digestion by Microwave: This method is useful for total decomposition of many different types of materials including rocks.

1. Consult CEM Microwave Sample Preparation Applications Manual for the microwave sample preparation note for the type of sample (e.g., Fe-oxides, tuff, etc...) to be dissolved. The application note discusses the amount of sample and reagents to be used, and program parameters to be entered for the microwave digestion.

Application Note = 054

2. Record dry weight of sample = .7272 g and place in a teflon PFA vessel.
3. Using a weighing boat, quantitatively add a known amount of $^{232}\text{U}/^{228}\text{Th}$ spike to the PFA vessel.

$^{232}\text{U}/^{228}\text{Th}$ spike # 25B

Reference Date 1/22/93

Reference Activity 204.88 pCi/g

Spike wt. 1.0152 g

3. Add reagents to vessel and record volumes:

Reagents	Volume (ml)
<u>HF</u>	<u>7</u>
<u>HCl</u>	<u>3</u>
<u>HNO₃</u>	<u>1</u>

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.

Extraction:

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 ~10 mg 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.
10. Dissolve the precipitate in ~3 ml conc HCl. Add 1 ml ultrapure water to dilute to ~9M.

Column Separation:

Resin: BIO-RAD Anion Exchange Resin AG 1-X8 100-200 mesh chloride form.
(Lot # 52096A)

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 12/14/95

***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 HNO₃)

Heat Th fraction to evaporate HCl
Add ~5 ml conc HNO₃ to dissolve residue
Add equal vol (~5 ml) DI water so soln 8M HNO₃
Load onto column in 8M HNO₃
Wash 3-4 column vols 8M HNO₃
Elute 4-5 column vols 9M HCl --> Th

✓
✓
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✓
✓

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✓

✓

Uranium Column (Biorad 0.7 cm diameter column with 10 cm resin; prewash with 4-5 column vols 8M HNO₃)

Evaoprate U fraction to near dryness
Pick up in about 2 ml conc HNO₃
Dilute with about 2 ml DI water to approx 8M HNO₃
Load onto column in 8M HNO₃
Wash 2 vols (8-10 ml) 8M HNO₃ --> Fe
Elute 4-5 vols 0.1M HCl --> U

✓
✓
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✓

✓

Source Preparation:

Thorium - OH⁻ precipitation onto filter

1. Evaporate solution containing Th to near dryness, add ~ 2 ml conc HNO₃ and evaporate to 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 12/20/95

Uranium - F⁻ precipitation onto filter

1. To the solution containing U, add 1 ml of 10% sodium hydrogen sulfate and 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 disappears 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 12/20/95

U/Th Digestion (Nopal rock samples)

Sample I. D. # NOPI-418-PWD

Date 12/11/95

Acid Digestion by Microwave: This method is useful for total decomposition of many different types of materials including rocks.

1. Consult CEM Microwave Sample Preparation Applications Manual for the microwave sample preparation note for the type of sample (e.g., Fe-oxides, tuff, etc...) to be dissolved. The application note discusses the amount of sample and reagents to be used, and program parameters to be entered for the microwave digestion.

Application Note = 054

2. Record dry weight of sample = .5744 g and place in a teflon PFA vessel.
3. Using a weighing boat, quantitatively add a known amount of $^{232}\text{U}/^{228}\text{Th}$ spike to the PFA vessel.

$^{232}\text{U}/^{228}\text{Th}$ spike # 25B

Reference Date 1/22/93

Reference Activity 204.88 pCi/g

Spike wt. 1.0032 g

3. Add reagents to vessel and record volumes:

Reagents	Volume (ml)
<u>HF</u>	<u>7</u>
<u>HCl</u>	<u>3</u>
<u>HNO₃</u>	<u>1</u>

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.

Extraction:

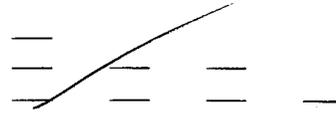
7. Add 1 ml of perchloric acid (HClO_4) to the sample solution in the teflon beaker. Evaporate to fumes of HClO_4 . Pick up in a small amount (~2 ml) of conc. HCl and dilute to approximately 2M (total ~10 ml).
8. Transfer solution to a 50 ml PP centrifuge tube. Add ~10 mg Fe carrier and coprecipitate 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.
10. Dissolve the precipitate in ~3 ml conc HCl. Add 1 ml ultrapure water to dilute to ~9M.

Column Separation:

Resin: BIO-RAD Anion Exchange Resin AG 1-X8 100-200 mesh chloride form.
(Lot # 52096A)

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

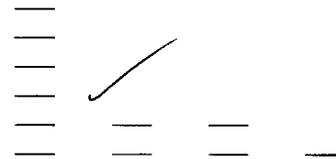


Separation Date 12/14/95

***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 HNO₃)

Heat Th fraction to evaporate HCl
Add ~5 ml conc HNO₃ to dissolve residue
Add equal vol (~5 ml) DI water so soln 8M HNO₃
Load onto column in 8M HNO₃
Wash 3-4 column vols 8M HNO₃
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 HNO₃)

Evaoprate U fraction to near dryness
Pick up in about 2 ml conc HNO₃
Dilute with about 2 ml DI water to approx 8M HNO₃
Load onto column in 8M HNO₃
Wash 2 vols (8-10 ml) 8M HNO₃ --> Fe
Elute 4-5 vols 0.1M HCl --> U



Source Preparation:

Thorium - OH⁻ precipitation onto filter

1. Evaporate solution containing Th to near dryness, add ~ 2 ml conc HNO₃ and evaporate to 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 12/20/95

Uranium - F⁻ precipitation onto filter

1. To the solution containing U, add 1 ml of 10% sodium hydrogen sulfate and 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 disappears 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 12/20/95

U/Th Digestion (Nopal rock samples)

Sample I. D. # NOPI-420-PWD

Date 12/11/95

Acid Digestion by Microwave: This method is useful for total decomposition of many different types of materials including rocks.

1. Consult CEM Microwave Sample Preparation Applications Manual for the microwave sample preparation note for the type of sample (e.g., Fe-oxides, tuff, etc...) to be dissolved. The application note discusses the amount of sample and reagents to be used, and program parameters to be entered for the microwave digestion.

Application Note = 054

2. Record dry weight of sample = .7867 g and place in a teflon PFA vessel.
3. Using a weighing boat, quantitatively add a known amount of $^{232}\text{U}/^{228}\text{Th}$ spike to the PFA vessel.

$^{232}\text{U}/^{228}\text{Th}$ spike # 25B

Reference Date 1/22/93

Reference Activity 204.88 pCi/g

Spike wt. 1.0064 g

3. Add reagents to vessel and record volumes:

Reagents	Volume (ml)
<u>HF</u>	<u>7</u>
<u>HCl</u>	<u>3</u>
<u>HNO₃</u>	<u>1</u>

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.

Extraction:

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 ~10 mg 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.
10. Dissolve the precipitate in ~3 ml conc HCl. Add 1 ml ultrapure water to dilute to ~9M.

Column Separation:

Resin: BIO-RAD Anion Exchange Resin AG 1-X8 100-200 mesh chloride form.
(Lot # 52096A)

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 12/14/95

***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 HNO₃)

Heat Th fraction to evaporate HCl
Add ~5 ml conc HNO₃ to dissolve residue
Add equal vol (~5 ml) DI water so soln 8M HNO₃
Load onto column in 8M HNO₃
Wash 3-4 column vols 8M HNO₃
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 HNO₃)

Evaoprate U fraction to near dryness
Pick up in about 2 ml conc HNO₃
Dilute with about 2 ml DI water to approx 8M HNO₃
Load onto column in 8M HNO₃
Wash 2 vols (8-10 ml) 8M HNO₃ --> Fe
Elute 4-5 vols 0.1M HCl --> U

___ ___

Source Preparation:

Thorium - OH⁻ precipitation onto filter

1. Evaporate solution containing Th to near dryness, add ~ 2 ml conc HNO₃ and evaporate to 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 12/20/95

Uranium - F⁻ precipitation onto filter

1. To the solution containing U, add 1 ml of 10% sodium hydrogen sulfate and 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 disappears 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 12/20/95

U/Th Digestion (Nopal rock samples)

Sample I. D. # NOPI-421-PWD

Date 12/11/95

Acid Digestion by Microwave: This method is useful for total decomposition of many different types of materials including rocks.

1. Consult CEM Microwave Sample Preparation Applications Manual for the microwave sample preparation note for the type of sample (e.g., Fe-oxides, tuff, etc...) to be dissolved. The application note discusses the amount of sample and reagents to be used, and program parameters to be entered for the microwave digestion.

Application Note = 054.

2. Record dry weight of sample = .4513 g and place in a teflon PFA vessel.
3. Using a weighing boat, quantitatively add a known amount of $^{232}\text{U}/^{228}\text{Th}$ spike to the PFA vessel.

$^{232}\text{U}/^{228}\text{Th}$ spike # 25B

Reference Date 1/22/93

Reference Activity 204.88 pCi/g

Spike wt. 1.0078 g

3. Add reagents to vessel and record volumes:

Reagents	Volume (ml)
<u>HF</u>	<u>7</u>
<u>HCl</u>	<u>3</u>
<u>HNO₃</u>	<u>1</u>

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.

Extraction:

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 ~10 mg 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.
10. Dissolve the precipitate in ~3 ml conc HCl. Add 1 ml ultrapure water to dilute to ~9M.

Column Separation:

Resin: BIO-RAD Anion Exchange Resin AG 1-X8 100-200 mesh chloride form.
(Lot # 52096A)

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 12/14/45

***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 HNO₃)

Heat Th fraction to evaporate HCl
Add ~5 ml conc HNO₃ to dissolve residue
Add equal vol (~5 ml) DI water so soln 8M HNO₃
Load onto column in 8M HNO₃
Wash 3-4 column vols 8M HNO₃
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 HNO₃)

Evaoprate U fraction to near dryness
Pick up in about 2 ml conc HNO₃
Dilute with about 2 ml DI water to approx 8M HNO₃
Load onto column in 8M HNO₃
Wash 2 vols (8-10 ml) 8M HNO₃ --> Fe
Elute 4-5 vols 0.1M HCl --> U

___ ___

Source Preparation:

Thorium - OH⁻ precipitation onto filter

1. Evaporate solution containing Th to near dryness, add ~ 2 ml conc HNO₃ and evaporate to 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 12/20/95

Uranium - F⁻ precipitation onto filter

1. To the solution containing U, add 1 ml of 10% sodium hydrogen sulfate and 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 disappears 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 12/20/95

U/Th Digestion (Nopal rock samples)

Sample I. D. # NOPI-423-PWD

Date 12/11/95

Acid Digestion by Microwave: This method is useful for total decomposition of many different types of materials including rocks.

1. Consult CEM Microwave Sample Preparation Applications Manual for the microwave sample preparation note for the type of sample (e.g., Fe-oxides, tuff, etc...) to be dissolved. The application note discusses the amount of sample and reagents to be used, and program parameters to be entered for the microwave digestion.

Application Note = 054

2. Record dry weight of sample = .7790 g and place in a teflon PFA vessel.
3. Using a weighing boat, quantitatively add a known amount of $^{232}\text{U}/^{228}\text{Th}$ spike to the PFA vessel.

$^{232}\text{U}/^{228}\text{Th}$ spike # 25B

Reference Date 1/22/93

Reference Activity 204.88 pCi/g

Spike wt. 1.0067 g

3. Add reagents to vessel and record volumes:

Reagents	Volume (ml)
<u>HF</u>	<u>7</u>
<u>HCl</u>	<u>3</u>
<u>HNO₃</u>	<u>1</u>

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.

Extraction:

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 ~10 mg 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.
10. Dissolve the precipitate in ~3 ml conc HCl. Add 1 ml ultrapure water to dilute to ~9M.

Column Separation:

Resin: BIO-RAD Anion Exchange Resin AG 1-X8 100-200 mesh chloride form.
(Lot # 52096A)

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

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Separation Date 12/14/95

***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 HNO₃)

Heat Th fraction to evaporate HCl
Add ~5 ml conc HNO₃ to dissolve residue
Add equal vol (~5 ml) DI water so soln 8M HNO₃
Load onto column in 8M HNO₃
Wash 3-4 column vols 8M HNO₃
Elute 4-5 column vols 9M HCl --> Th

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Uranium Column (Biorad 0.7 cm diameter column with 10 cm resin; prewash with 4-5 column vols 8M HNO₃)

Evaoprate U fraction to near dryness
Pick up in about 2 ml conc HNO₃
Dilute with about 2 ml DI water to approx 8M HNO₃
Load onto column in 8M HNO₃
Wash 2 vols (8-10 ml) 8M HNO₃ --> Fe
Elute 4-5 vols 0.1M HCl --> U

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Source Preparation:

Thorium - OH⁻ precipitation onto filter

1. Evaporate solution containing Th to near dryness, add ~ 2 ml conc HNO₃ and evaporate to 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 12/20/95

Uranium - F⁻ precipitation onto filter

1. To the solution containing U, add 1 ml of 10% sodium hydrogen sulfate and 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 disappears 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 12/20/95

U/Th Digestion (Nopal rock samples)

Sample I. D. # NOPI-425-PWD

Date 12/11/95

Acid Digestion by Microwave: This method is useful for total decomposition of many different types of materials including rocks.

1. Consult CEM Microwave Sample Preparation Applications Manual for the microwave sample preparation note for the type of sample (e.g., Fe-oxides, tuff, etc...) to be dissolved. The application note discusses the amount of sample and reagents to be used, and program parameters to be entered for the microwave digestion.

Application Note = 054.

2. Record dry weight of sample = .6650 g and place in a teflon PFA vessel.
3. Using a weighing boat, quantitatively add a known amount of $^{232}\text{U}/^{228}\text{Th}$ spike to the PFA vessel.

$^{232}\text{U}/^{228}\text{Th}$ spike # 25B

Reference Date 1/22/93

Reference Activity 204.88 pCi/g

Spike wt. 1.0076 g

3. Add reagents to vessel and record volumes:

Reagents	Volume (ml)
<u>HF</u>	<u>7</u>
<u>HCl</u>	<u>3</u>
<u>H₂O₂</u>	<u>1</u>

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.

Extraction:

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 ~10 mg 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.
10. Dissolve the precipitate in ~3 ml conc HCl. Add 1 ml ultrapure water to dilute to ~9M.

Column Separation:

Resin: BIO-RAD Anion Exchange Resin AG 1-X8 100-200 mesh chloride form.
(Lot # 52096A)

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 12/14/95

***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 HNO₃)

Heat Th fraction to evaporate HCl
Add ~5 ml conc HNO₃ to dissolve residue
Add equal vol (~5 ml) DI water so soln 8M HNO₃
Load onto column in 8M HNO₃
Wash 3-4 column vols 8M HNO₃
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 HNO₃)

Evaoprate U fraction to near dryness
Pick up in about 2 ml conc HNO₃
Dilute with about 2 ml DI water to approx 8M HNO₃
Load onto column in 8M HNO₃
Wash 2 vols (8-10 ml) 8M HNO₃ --> Fe
Elute 4-5 vols 0.1M HCl --> U

Source Preparation:

Thorium - OH⁻ precipitation onto filter

1. Evaporate solution containing Th to near dryness, add ~ 2 ml conc HNO₃ and evaporate to 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 12/20/95

Uranium - F⁻ precipitation onto filter

1. To the solution containing U, add 1 ml of 10% sodium hydrogen sulfate and 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 disappears 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 12/20/95

U/Th Digestion (Nopal rock samples)

Sample I. D. # NOPE-417-PWDA

Date 12-27-95

Acid Digestion by Microwave: This method is useful for total decomposition of many different types of materials including rocks.

1. Consult CEM Microwave Sample Preparation Applications Manual for the microwave sample preparation note for the type of sample (e.g., Fe-oxides, tuff, etc...) to be dissolved. The application note discusses the amount of sample and reagents to be used, and program parameters to be entered for the microwave digestion.

Application Note = _____.

2. Record dry weight of sample = _____ g and place in a teflon PFA vessel.
3. Using a weighing boat, quantitatively add a known amount of $^{232}\text{U}/^{228}\text{Th}$ spike to the PFA vessel.

$^{232}\text{U}/^{228}\text{Th}$ 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.

Extraction:

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 ~10 mg 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.
10. Dissolve the precipitate in ~3 ml conc HCl. Add 1 ml ultrapure water to dilute to ~9M.

Column Separation:

Resin: BIO-RAD Anion Exchange Resin AG 1-X8 100-200 mesh chloride form.
(Lot # 52096A)

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 12/28/95

***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 HNO₃)

Heat Th fraction to evaporate HCl
Add ~5 ml conc HNO₃ to dissolve residue
Add equal vol (~5 ml) DI water so soln 8M HNO₃
Load onto column in 8M HNO₃
Wash 3-4 column vols 8M HNO₃
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 HNO₃)

Evaoprate U fraction to near dryness
Pick up in about 2 ml conc HNO₃
Dilute with about 2 ml DI water to approx 8M HNO₃
Load onto column in 8M HNO₃
Wash 2 vols (8-10 ml) 8M HNO₃ --> Fe
Elute 4-5 vols 0.1M HCl --> U

✓
✓
✓
✓
✓
✓

Source Preparation:

Thorium - OH⁻ precipitation onto filter

1. Evaporate solution containing Th to near dryness, add ~ 2 ml conc HNO₃ and evaporate to 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 1/3/96

Uranium - F⁻ precipitation onto filter

1. To the solution containing U, add 1 ml of 10% sodium hydrogen sulfate and 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 disappears 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 1/3/96

U/Th Digestion (Nopal rock samples)

Sample I. D. # W0PI-418-PWD A

Date 12/27/95

Acid Digestion by Microwave: This method is useful for total decomposition of many different types of materials including rocks.

1. Consult CEM Microwave Sample Preparation Applications Manual for the microwave sample preparation note for the type of sample (e.g., Fe-oxides, tuff, etc...) to be dissolved. The application note discusses the amount of sample and reagents to be used, and program parameters to be entered for the microwave digestion.

Application Note = _____.

2. Record dry weight of sample = _____ g and place in a teflon PFA vessel.
3. Using a weighing boat, quantitatively add a known amount of $^{232}\text{U}/^{228}\text{Th}$ spike to the PFA vessel.

$^{232}\text{U}/^{228}\text{Th}$ 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.

Extraction:

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 ~10 mg 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 scavenge by centrifugation and decant. Wash the precipitate with ultrapure water, centrifuge, and decant. Repeat washing.
10. Dissolve the precipitate in ~3 ml conc HCl. Add 1 ml ultrapure water to dilute to ~9M.

Column Separation:

Resin: BIO-RAD Anion Exchange Resin AG 1-X8 100-200 mesh chloride form.
(Lot # 52096A)

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 12 | 28 | 95

***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 HNO₃)

Heat Th fraction to evaporate HCl
Add ~5 ml conc HNO₃ to dissolve residue
Add equal vol (~5 ml) DI water so soln 8M HNO₃
Load onto column in 8M HNO₃
Wash 3-4 column vols 8M HNO₃
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 HNO₃)

Evaoprate U fraction to near dryness
Pick up in about 2 ml conc HNO₃
Dilute with about 2 ml DI water to approx 8M HNO₃
Load onto column in 8M HNO₃
Wash 2 vols (8-10 ml) 8M HNO₃ --> Fe
Elute 4-5 vols 0.1M HCl --> U



Source Preparation:

Thorium - OH⁻ precipitation onto filter

1. Evaporate solution containing Th to near dryness, add ~ 2 ml conc HNO₃ and evaporate to 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 1/3/74

Uranium - F⁻ precipitation onto filter

1. To the solution containing U, add 1 ml of 10% sodium hydrogen sulfate and 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 disappears 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 1/3/96

U/Th Digestion (Nopal rock samples)

Sample I. D. # NOPI-420-PWD A

Date 12/27/95

Acid Digestion by Microwave: This method is useful for total decomposition of many different types of materials including rocks.

1. Consult CEM Microwave Sample Preparation Applications Manual for the microwave sample preparation note for the type of sample (e.g., Fe-oxides, tuff, etc...) to be dissolved. The application note discusses the amount of sample and reagents to be used, and program parameters to be entered for the microwave digestion.

Application Note = _____

2. Record dry weight of sample = _____ g and place in a teflon PFA vessel.
3. Using a weighing boat, quantitatively add a known amount of $^{232}\text{U}/^{228}\text{Th}$ spike to the PFA vessel.

$^{232}\text{U}/^{228}\text{Th}$ 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.

Extraction:

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 ~10 mg 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.
10. Dissolve the precipitate in ~3 ml conc HCl. Add 1 ml ultrapure water to dilute to ~9M.

Column Separation:

Resin: BIO-RAD Anion Exchange Resin AG 1-X8 100-200 mesh chloride form.
(Lot # 52096A)

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 12/28/97

***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 HNO₃)

Heat Th fraction to evaporate HCl
Add ~5 ml conc HNO₃ to dissolve residue
Add equal vol (~5 ml) DI water so soln 8M HNO₃
Load onto column in 8M HNO₃
Wash 3-4 column vols 8M HNO₃
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 HNO₃)

Evaoprate U fraction to near dryness
Pick up in about 2 ml conc HNO₃
Dilute with about 2 ml DI water to approx 8M HNO₃
Load onto column in 8M HNO₃
Wash 2 vols (8-10 ml) 8M HNO₃ --> Fe
Elute 4-5 vols 0.1M HCl --> U

Source Preparation:

Thorium - OH⁻ precipitation onto filter

1. Evaporate solution containing Th to near dryness. add ~ 2 ml conc HNO₃ and evaporate to 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 μ l 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 μ g 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 1/3/96

Uranium - F⁻ precipitation onto filter

1. To the solution containing U, add 1 ml of 10% sodium hydrogen sulfate and 50 μ g 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 disappears 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 1/3/96

U/Th Digestion (Nopal rock samples)

Sample I. D. # NOPI-421-PWDA

Date 12/27/95

Acid Digestion by Microwave: This method is useful for total decomposition of many different types of materials including rocks.

1. Consult CEM Microwave Sample Preparation Applications Manual for the microwave sample preparation note for the type of sample (e.g., Fe-oxides, tuff, etc...) to be dissolved. The application note discusses the amount of sample and reagents to be used, and program parameters to be entered for the microwave digestion.

Application Note = _____.

2. Record dry weight of sample = _____ g and place in a teflon PFA vessel.
3. Using a weighing boat, quantitatively add a known amount of $^{232}\text{U}/^{228}\text{Th}$ spike to the PFA vessel.

$^{232}\text{U}/^{228}\text{Th}$ 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.

Extraction:

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 ~10 mg 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 scavenge by centrifugation and decant. Wash the precipitate with ultrapure water, centrifuge, and decant. Repeat washing.
 10. Dissolve the precipitate in ~3 ml conc HCl. Add 1 ml ultrapure water to dilute to ~9M.
-

Column Separation:

Resin: BIO-RAD Anion Exchange Resin AG 1-X8 100-200 mesh chloride form.
(Lot # 52096A)

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 12/27/95

***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 HNO₃)

Heat Th fraction to evaporate HCl
Add ~5 ml conc HNO₃ to dissolve residue
Add equal vol (~5 ml) DI water so soln 8M HNO₃
Load onto column in 8M HNO₃
Wash 3-4 column vols 8M HNO₃
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 HNO₃)

Evaoprate U fraction to near dryness
Pick up in about 2 ml conc HNO₃
Dilute with about 2 ml DI water to approx 8M HNO₃
Load onto column in 8M HNO₃
Wash 2 vols (8-10 ml) 8M HNO₃ --> Fe
Elute 4-5 vols 0.1M HCl --> U

Source Preparation:

Thorium - OH⁻ precipitation onto filter

1. Evaporate solution containing Th to near dryness, add ~ 2 ml conc HNO₃ and evaporate to 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 1/3/96

Uranium - F⁻ precipitation onto filter

1. To the solution containing U, add 1 ml of 10% sodium hydrogen sulfate and 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 disappears 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 1/3/96

U/Th Digestion (Nopal rock samples)

Sample I. D. # NOPI-423-PWDA

Date 12/27/95

Acid Digestion by Microwave: This method is useful for total decomposition of many different types of materials including rocks.

1. Consult CEM Microwave Sample Preparation Applications Manual for the microwave sample preparation note for the type of sample (e.g., Fe-oxides, tuff, etc...) to be dissolved. The application note discusses the amount of sample and reagents to be used, and program parameters to be entered for the microwave digestion.

Application Note = _____

2. Record dry weight of sample = _____ g and place in a teflon PFA vessel.
3. Using a weighing boat, quantitatively add a known amount of $^{232}\text{U}/^{228}\text{Th}$ spike to the PFA vessel.

$^{232}\text{U}/^{228}\text{Th}$ 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.

Extraction:

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 ~10 mg 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.
10. Dissolve the precipitate in ~3 ml conc HCl. Add 1 ml ultrapure water to dilute to ~9M.

Column Separation:

Resin: BIO-RAD Anion Exchange Resin AG 1-X8 100-200 mesh chloride form.
(Lot # 52096A)

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 12/28/95

***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 HNO₃)

Heat Th fraction to evaporate HCl
Add ~5 ml conc HNO₃ to dissolve residue
Add equal vol (~5 ml) DI water so soln 8M HNO₃
Load onto column in 8M HNO₃
Wash 3-4 column vols 8M HNO₃
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 HNO₃)

Evaoprate U fraction to near dryness
Pick up in about 2 ml conc HNO₃
Dilute with about 2 ml DI water to approx 8M HNO₃
Load onto column in 8M HNO₃
Wash 2 vols (8-10 ml) 8M HNO₃ --> Fe
Elute 4-5 vols 0.1M HCl --> U

Source Preparation:

Thorium - OH⁻ precipitation onto filter

1. Evaporate solution containing Th to near dryness, add ~ 2 ml conc HNO₃ and evaporate to 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 1/3/96

Uranium - F⁻ precipitation onto filter

1. To the solution containing U, add 1 ml of 10% sodium hydrogen sulfate and 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 substate 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 1/3/96

U/Th Digestion (Nopal rock samples)

Sample I. D. # N0PI-425-PWDA

Date 12/27/95

Acid Digestion by Microwave: This method is useful for total decomposition of many different types of materials including rocks.

1. Consult CEM Microwave Sample Preparation Applications Manual for the microwave sample preparation note for the type of sample (e.g., Fe-oxides, tuff, etc...) to be dissolved. The application note discusses the amount of sample and reagents to be used, and program parameters to be entered for the microwave digestion.

Application Note = _____

2. Record dry weight of sample = _____ g and place in a teflon PFA vessel.
3. Using a weighing boat, quantitatively add a known amount of $^{232}\text{U}/^{228}\text{Th}$ spike to the PFA vessel.

$^{232}\text{U}/^{228}\text{Th}$ 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.

Extraction:

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 ~10 mg 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.
10. Dissolve the precipitate in ~3 ml conc HCl. Add 1 ml ultrapure water to dilute to ~9M.

Column Separation:

Resin: BIO-RAD Anion Exchange Resin AG 1-X8 100-200 mesh chloride form.
(Lot # 52096A)

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 12/28/25

***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 HNO₃)

Heat Th fraction to evaporate HCl
Add ~5 ml conc HNO₃ to dissolve residue
Add equal vol (~5 ml) DI water so soln 8M HNO₃
Load onto column in 8M HNO₃
Wash 3-4 column vols 8M HNO₃
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 HNO₃)

Evaoprate U fraction to near dryness
Pick up in about 2 ml conc HNO₃
Dilute with about 2 ml DI water to approx 8M HNO₃
Load onto column in 8M HNO₃
Wash 2 vols (8-10 ml) 8M HNO₃ --> Fe
Elute 4-5 vols 0.1M HCl --> U

___ ___

Source Preparation:

Thorium - OH⁻ precipitation onto filter

1. Evaporate solution containing Th to near dryness, add ~ 2 ml conc HNO₃ and evaporate to 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 1/3/96

Uranium - F⁻ precipitation onto filter

1. To the solution containing U, add 1 ml of 10% sodium hydrogen sulfate and 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 disappears 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 1/3/96

U/Th Digestion (Nopal rock samples)

Sample I. D. # NDPI-494-SEPL C

Date 2/28/96

Acid Digestion by Microwave: This method is useful for total decomposition of many different types of materials including rocks.

1. Consult CEM Microwave Sample Preparation Applications Manual for the microwave sample preparation note for the type of sample (e.g., Fe-oxides, tuff, etc...) to be dissolved. The application note discusses the amount of sample and reagents to be used, and program parameters to be entered for the microwave digestion.

Application Note = _____

2. Record dry weight of sample = _____ g and place in a teflon PFA vessel.
3. Using a weighing boat, quantitatively add a known amount of $^{232}\text{U}/^{228}\text{Th}$ spike to the PFA vessel.

$^{232}\text{U}/^{228}\text{Th}$ spike # 25A

Reference Date 1/22/93

Reference Activity 2.051 $\mu\text{Ci/g}$

Spike wt. 4.7538 ^{3.7507} 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.

Extraction:

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 ~10 mg 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 scavenge by centrifugation and decant. Wash the precipitate with ultrapure water, centrifuge, and decant. Repeat washing.
10. Dissolve the precipitate in ~3 ml conc HCl. Add 1 ml ultrapure water to dilute to ~9M.

Column Separation:

Resin: BIO-RAD Anion Exchange Resin AG 1-X8 100-200 mesh chloride form.

Lot # _____

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 3/4/96
~~2/29/96~~

***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 HNO₃)

Heat Th fraction to evaporate HCl

Add ~5 ml conc HNO₃ to dissolve residue

Add equal vol (~5 ml) DI water so soln 8M HNO₃

Load onto column in 8M HNO₃

Wash 3-4 column vols 8M HNO₃

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 HNO₃)

Evaoprate U fraction to near dryness

Pick up in about 2 ml conc HNO₃

Dilute with about 2 ml DI water to approx 8M HNO₃

Load onto column in 8M HNO₃

Wash 2 vols (8-10 ml) 8M HNO₃ --> Fe

Elute 4-5 vols 0.1M HCl --> U

Source Preparation:

Thorium - OH⁻ precipitation onto filter

1. Evaporate solution containing Th to near dryness, add ~ 2 ml conc HNO₃ and evaporate to 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 3/7/96

Uranium - F⁻ precipitation onto filter

1. To the solution containing U, add 1 ml of 10% sodium hydrogen sulfate and 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 disappears 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 3/7/96

U/Th Digestion (Nopal rock samples)

Sample I. D. # NOPI-494-SEP2(C)

Date 2/28/96

Acid Digestion by Microwave: This method is useful for total decomposition of many different types of materials including rocks.

1. Consult CEM Microwave Sample Preparation Applications Manual for the microwave sample preparation note for the type of sample (e.g., Fe-oxides, tuff, etc...) to be dissolved. The application note discusses the amount of sample and reagents to be used, and program parameters to be entered for the microwave digestion.

Application Note = _____

2. Record dry weight of sample = 0.0489 g and place in a teflon PFA vessel.
3. Using a weighing boat, quantitatively add a known amount of $^{232}\text{U}/^{228}\text{Th}$ spike to the PFA vessel.

$^{232}\text{U}/^{228}\text{Th}$ spike # 25A

Reference Date 1/22/93

Reference Activity 2.051 $\mu\text{Ci/g}$

Spike wt. 4.2977 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.

Extraction:

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 ~10 mg 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.
10. Dissolve the precipitate in ~3 ml conc HCl. Add 1 ml ultrapure water to dilute to ~9M.

Column Separation:

Resin: BIO-RAD Anion Exchange Resin AG 1-X8 100-200 mesh chloride form.

Lot # _____

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 2/28/96

***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 HNO₃)

Heat Th fraction to evaporate HCl

Add ~5 ml conc HNO₃ to dissolve residue

Add equal vol (~5 ml) DI water so soln 8M HNO₃

Load onto column in 8M HNO₃

Wash 3-4 column vols 8M HNO₃

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 HNO₃)

Evaporate U fraction to near dryness

Pick up in about 2 ml conc HNO₃

Dilute with about 2 ml DI water to approx 8M HNO₃

Load onto column in 8M HNO₃

Wash 2 vols (8-10 ml) 8M HNO₃ --> Fe

Elute 4-5 vols 0.1M HCl --> U

Source Preparation:

Thorium - OH⁻ precipitation onto filter

1. Evaporate solution containing Th to near dryness, add ~ 2 ml conc HNO₃ and evaporate to 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 3/4/96

Uranium - F⁻ precipitation onto filter

1. To the solution containing U, add 1 ml of 10% sodium hydrogen sulfate and 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 disappears 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 3/4/96

U/Th Digestion (Nopal rock samples)

Sample I. D. # NOPI-444-SEP3 (C)

Date 2/28/96

Acid Digestion by Microwave: This method is useful for total decomposition of many different types of materials including rocks.

1. Consult CEM Microwave Sample Preparation Applications Manual for the microwave sample preparation note for the type of sample (e.g., Fe-oxides, tuff, etc...) to be dissolved. The application note discusses the amount of sample and reagents to be used, and program parameters to be entered for the microwave digestion.

Application Note = _____

2. Record dry weight of sample = .0353 g and place in a teflon PFA vessel.
3. Using a weighing boat, quantitatively add a known amount of $^{232}\text{U}/^{228}\text{Th}$ spike to the PFA vessel.

$^{232}\text{U}/^{228}\text{Th}$ spike # 25A

Reference Date 1/22/93

Reference Activity 2.051 $\mu\text{Ci/g}$

Spike wt. 3.8516 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.

Extraction:

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 ~10 mg 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.
10. Dissolve the precipitate in ~3 ml conc HCl. Add 1 ml ultrapure water to dilute to ~9M.

Column Separation:

Resin: BIO-RAD Anton Exchange Resin AG 1-X8 100-200 mesh chloride form.
(Lot # _____)

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 2/28/96

***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 HNO₃)

Heat Th fraction to evaporate HCl _____
Add ~5 ml conc HNO₃ to dissolve residue _____
Add equal vol (~5 ml) DI water so soln 8M HNO₃ _____
Load onto column in 8M HNO₃ _____
Wash 3-4 column vols 8M HNO₃ _____
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 HNO₃)

Evaoprate U fraction to near dryness _____
Pick up in about 2 ml conc HNO₃ _____
Dilute with about 2 ml DI water to approx 8M HNO₃ _____
Load onto column in 8M HNO₃ _____
Wash 2 vols (8-10 ml) 8M HNO₃ --> Fe _____
Elute 4-5 vols 0.1M HCl --> U _____

Source Preparation:

Thorium - OH⁻ precipitation onto filter

1. Evaporate solution containing Th to near dryness, add ~ 2 ml conc HNO₃ and evaporate to 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 3/4/96

Uranium - F⁻ precipitation onto filter

1. To the solution containing U, add 1 ml of 10% sodium hydrogen sulfate and 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 disappears 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 3/4/96

U/Th Digestion (Nopal rock samples)

Sample I. D. # NOPI-494-SEP4

Date 2/28/96

Acid Digestion by Microwave: This method is useful for total decomposition of many different types of materials including rocks.

1. Consult CEM Microwave Sample Preparation Applications Manual for the microwave sample preparation note for the type of sample (e.g., Fe-oxides, tuff, etc...) to be dissolved. The application note discusses the amount of sample and reagents to be used, and program parameters to be entered for the microwave digestion.

Application Note = _____

2. Record dry weight of sample = .035 g and place in a teflon PFA vessel.
3. Using a weighing boat, quantitatively add a known amount of $^{232}\text{U}/^{228}\text{Th}$ spike to the PFA vessel.

$^{232}\text{U}/^{228}\text{Th}$ spike # 25A

Reference Date 1/22/93

Reference Activity 2.051 $\mu\text{Ci/g}$

Spike wt. 3.3388 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.

Extraction:

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 ~10 mg 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.
10. Dissolve the precipitate in ~3 ml conc HCl. Add 1 ml ultrapure water to dilute to ~9M.

Column Separation:

Resin: BIO-RAD Anion Exchange Resin AG 1-X8 100-200 mesh chloride form.

Lot # _____

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 2/28/91

***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 HNO₃)

Heat Th fraction to evaporate HCl

Add ~5 ml conc HNO₃ to dissolve residue

Add equal vol (~5 ml) DI water so soln 8M HNO₃

Load onto column in 8M HNO₃

Wash 3-4 column vols 8M HNO₃

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 HNO₃)

Evaporate U fraction to near dryness

Pick up in about 2 ml conc HNO₃

Dilute with about 2 ml DI water to approx 8M HNO₃

Load onto column in 8M HNO₃

Wash 2 vols (8-10 ml) 8M HNO₃ --> Fe

Elute 4-5 vols 0.1M HCl --> U

Source Preparation:

Thorium - OH⁻ precipitation onto filter

1. Evaporate solution containing Th to near dryness. add ~ 2 ml conc HNO₃ and evaporate to 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 3/4/96

Uranium - F⁻ precipitation onto filter

1. To the solution containing U, add 1 ml of 10% sodium hydrogen sulfate and 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 3/4/96

U/Th Digestion (Nopal rock samples)

Sample I. D. # NOPI-494-SEPS

Date 2/28/96

Acid Digestion by Microwave: This method is useful for total decomposition of many different types of materials including rocks.

1. Consult CEM Microwave Sample Preparation Applications Manual for the microwave sample preparation note for the type of sample (e.g., Fe-oxides, tuff, etc...) to be dissolved. The application note discusses the amount of sample and reagents to be used, and program parameters to be entered for the microwave digestion.

Application Note = _____

2. Record dry weight of sample = .0296 g and place in a teflon PFA vessel.
3. Using a weighing boat, quantitatively add a known amount of $^{232}\text{U}/^{228}\text{Th}$ spike to the PFA vessel.

$^{232}\text{U}/^{228}\text{Th}$ spike # 25A

Reference Date 1/22/93

Reference Activity 2.051 $\mu\text{Ci/g}$

Spike wt. 3.8403 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.

Extraction:

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 ~10 mg 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.
10. Dissolve the precipitate in ~3 ml conc HCl. Add 1 ml ultrapure water to dilute to ~9M.

Column Separation:

Resin: BIO-RAD Anion Exchange Resin AG 1-X8 100-200 mesh chloride form.

Lot # _____

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 2/28/91

***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 HNO₃)

Heat Th fraction to evaporate HCl

Add ~5 ml conc HNO₃ to dissolve residue

Add equal vol (~5 ml) DI water so soln 8M HNO₃

Load onto column in 8M HNO₃

Wash 3-4 column vols 8M HNO₃

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 HNO₃)

Evaporate U fraction to near dryness

Pick up in about 2 ml conc HNO₃

Dilute with about 2 ml DI water to approx 8M HNO₃

Load onto column in 8M HNO₃

Wash 2 vols (8-10 ml) 8M HNO₃ --> Fe

Elute 4-5 vols 0.1M HCl --> U

Source Preparation:

Thorium - OH⁻ precipitation onto filter

1. Evaporate solution containing Th to near dryness, add ~ 2 ml conc HNO₃ and evaporate to 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 3/4/96

Uranium - F⁻ precipitation onto filter

1. To the solution containing U, add 1 ml of 10% sodium hydrogen sulfate and 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 disappears 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 3/4/96

U/Th Digestion (Nopal rock samples)

Sample I. D. # NOPI-494-SEP6

Date 2/28/96

Acid Digestion by Microwave: This method is useful for total decomposition of many different types of materials including rocks.

1. Consult CEM Microwave Sample Preparation Applications Manual for the microwave sample preparation note for the type of sample (e.g., Fe-oxides, tuff, etc...) to be dissolved. The application note discusses the amount of sample and reagents to be used, and program parameters to be entered for the microwave digestion.

Application Note = _____

2. Record dry weight of sample = .0481 g and place in a teflon PFA vessel.
3. Using a weighing boat, quantitatively add a known amount of $^{232}\text{U}/^{228}\text{Th}$ spike to the PFA vessel.

$^{232}\text{U}/^{228}\text{Th}$ spike # 25A

Reference Date 1/22/93

Reference Activity 2.051 $\mu\text{Ci/g}$

Spike wt. 3.8203 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.

Extraction:

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 ~10 mg 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.
10. Dissolve the precipitate in ~3 ml conc HCl. Add 1 ml ultrapure water to dilute to ~9M.