



# Paragon Analytics

## Radiochemistry Case Narrative

### Isotopic Thorium

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#### **New Horizons**

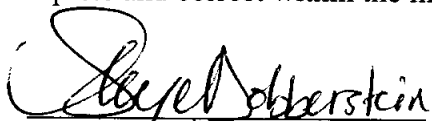
CSMRI / 2135

PA WO 0404284

1. This report consists of the analytical results for three soil samples received by Paragon on 04/28/04.
2. These samples were prepared according to Paragon Analytics procedures PA SOP773R8, PA SOP777R7, and PA SOP721R10.
3. The samples were analyzed for the presence of isotopic thorium according to Paragon Analytics procedure PA SOP714R8. The analyses were completed on 06/02/04.
4. The isotopic analysis results for these samples are reported on a dry weight basis in units of pCi/gram.
5. Sample H-10-2 (PA ID 0404284-3) was prepared in batch AS040520-5 at a reduced aliquot of 1.0 grams and a further reduced replicate aliquot of 0.1 grams due to elevated activity detected in the prescreen results. Only the replicate sample was counted, and adequate spectral quality was obtained, producing accurate quantification of the results. The results of the replicate sample are submitted in this report.
6. Due to the reduced aliquot used to prepare this sample, the requested MDC of 0.1 pCi/g was not met for this sample or its duplicate. Likewise, the requested MDC was not met for Th-228 and Th-230 in sample Area 1 Bottom (PA ID 0404284-1). In all cases, the reported activity exceeds the achieved MDC value, and the samples are identified with "M3" flags on the final reports.
7. Th-232 activity is reported in method blank AS040520-5MB above the minimum detectable concentration value. The measured blank activity is below the requested MDC (0.1 pCi/g). Results are acceptable according to PA SOP 715, and are submitted without further qualification.
8. No further anomalous situations were encountered during the preparation or analysis of these samples. All remaining quality control criteria were met.

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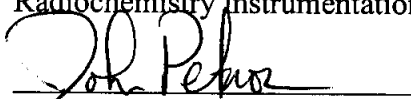
The data contained in the following report have been reviewed and approved by the personnel listed below. In addition, Paragon Analytics certifies that the analyses reported herein are true, complete and correct within the limits of the methods employed.



Skye Dobberstein  
Radiochemistry Instrumentation

6/10/04

Date



Radiochemistry Final Data Review

6/11/04

Date

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# Isotopic Thorium By Alpha Spectroscopy

PAI 714 Rev 8

## Method Blank Results

Lab Name: Paragon Analytics

Work Order Number: 0404284

Client Name: New Horizons

ClientProject ID: CSMRI 2135

Lab ID: AS040520-4MB

Sample Matrix: SOIL

Prep Batch: AS040520-4

Final Aliquot: 2.00 g

Prep SOP: PAI 777 Rev 7

QCBatchID: AS040520-4-1

Result Units: pCi/g

Date Collected: 20-May-04

Run ID: AS040520-4A

File Name: T5204B

Date Prepared: 20-May-04

Count Time: 300 minutes

Date Analyzed: 28-May-04

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Lab Qualifier
14274-82-9	Th-228	0.005 +/- 0.033	0.077	U
14269-63-7	Th-230	0.048 +/- 0.047	0.086	U
7440-29-1	Th-232	0.006 +/- 0.016	0.028	U

### Chemical Yield Summary

Carrier/Tracer	Amount Added	Result	Units	Yield	Control Limits	Flag
Th-229	2.252	1.47	pCi/g	65.5	30 - 110 %	

### Comments:

#### Qualifiers/Flags:

U - Result is less than the sample specific MDC.

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

LT - Result is less than Requested MDC, greater than sample specific MDC.

#### Abbreviations:

TPU - Total Propagated Uncertainty (see PAI SOP 743)

MDC - Minimum Detectable Concentration (see PAI SOP 709)

BDL - Below Detection Limit

M - Requested MDC not met.

B - Analyte concentration greater than MDC.

B3 - Analyte concentration greater than MDC but less than Requested MDC.

Data Package ID: TH0404284-1

# Isotopic Thorium By Alpha Spectroscopy

PAI 714 Rev 8

## Method Blank Results

Lab Name: Paragon Analytics

Work Order Number: 0404284

Client Name: New Horizons

ClientProject ID: CSMRI 2135

Lab ID: AS040520-5MB

Sample Matrix: SOIL  
Prep SOP: PAI 777 Rev 7  
Date Collected: 20-May-04  
Date Prepared: 20-May-04  
Date Analyzed: 29-May-04

Prep Batch: AS040520-5  
QCBatchID: AS040520-5-1  
Run ID: AS040523-2A  
Count Time: 655 minutes

Final Aliquot: 1.00 g  
Result Units: pCi/g  
File Name: T5205B

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Lab Qualifier
14274-82-9	Th-228	0.009 +/- 0.030	0.059	U
14269-63-7	Th-230	0.048 +/- 0.056	0.098	U
7440-29-1	Th-232	0.035 +/- 0.022	0.009	B3

### Chemical Yield Summary

Carrier/Tracer	Amount Added	Result	Units	Yield	Control Limits	Flag
Th-229	4.504	3.32	pCi/g	73.7	30 - 110 %	

### Comments:

#### Qualifiers/Flags:

U - Result is less than the sample specific MDC.  
Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.  
Y2 - Chemical Yield outside default limits.  
LT - Result is less than Requested MDC, greater than sample specific MDC.

#### Abbreviations:

TPU - Total Propagated Uncertainty (see PAI SOP 743)  
MDC - Minimum Detectable Concentration (see PAI SOP 709)  
BDL - Below Detection Limit

M - Requested MDC not met.  
B - Analyte concentration greater than MDC.  
B3 - Analyte concentration greater than MDC but less than Requested MDC.

Data Package ID: TH0404284-1

# Isotopic Thorium By Alpha Spectroscopy

PAI 714 Rev 8

## Laboratory Control Sample(s)

Lab Name: Paragon Analytics

Work Order Number: 0404284

Client Name: New Horizons

ClientProject ID: CSMRI 2135

<b>Lab ID:</b> AS040520-4LCS	<b>Sample Matrix:</b> SOIL	<b>Prep Batch:</b> AS040520-4	<b>Final Aliquot:</b> 2.00 g
	<b>Prep SOP:</b> PAI 777 Rev 7	<b>QCBatchID:</b> AS040520-4-1	<b>Result Units:</b> pCi/g
	<b>Date Collected:</b> 20-May-04	<b>Run ID:</b> AS040520-4A	<b>File Name:</b> T5204L
	<b>Date Prepared:</b> 20-May-04	<b>Count Time:</b> 300 minutes	
	<b>Date Analyzed:</b> 28-May-04		

CASNO	Target Nuclide	Results +/- 2s TPU	MDC	Spike Added	% Rec	Control Limits	Lab Qualifier
14269-63-7	Th-230	2.50 +/- 0.46	0.08	2.30	109	85 - 121	P

## Chemical Yield Summary

Carrier/Tracer	Amount Added	Result	Units	Yield	Control Limits	Flag
Th-229	2.252	1.55	pCi/g	68.9	30 - 110 %	

### Comments:

#### Qualifiers/Flags:

- U - Result is less than the sample specific MDC.
- LT - Result is less than Requested MDC, greater than sample specific MDC.
- Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.
- Y2 - Chemical Yield outside default limits.
- L - LCS Recovery below lower control limit.
- H - LCS Recovery above upper control limit.
- P - LCS Recovery within control limits.
- M - The requested MDC was not met.
- M3 - The requested MDC was not met, but thereported activity is greater than the reported MDC.

#### Abbreviations:

- TPU - Total Propagated Uncertainty (see PAI SOP 743)
- MDC - Minimum Detectable Concentration (see PAI SOP 709)

Data Package ID: TH0404284-1

# Isotopic Thorium By Alpha Spectroscopy

PAI 714 Rev 8

## Laboratory Control Sample(s)

Lab Name: Paragon Analytics

Work Order Number: 0404284

Client Name: New Horizons

ClientProject ID: CSMRI 2135

Lab ID: AS040520-5LCS

Sample Matrix: SOIL  
Prep SOP: PAI 777 Rev 7  
Date Collected: 20-May-04  
Date Prepared: 20-May-04  
Date Analyzed: 28-May-04

Prep Batch: AS040520-5  
QCBatchID: AS040520-5-1  
Run ID: AS040523-2A  
Count Time: 300 minutes

Final Aliquot: 1.00 g  
Result Units: pCi/g  
File Name: T5205L

CASNO	Target Nuclide	Results +/- 2s TPU	MDC	Spike Added	% Rec	Control Limits	Lab Qualifier
14269-63-7	Th-230	5.07 +/- 0.93	0.15	4.59	110	85 - 121	P,M3

## Chemical Yield Summary

Carrier/Tracer	Amount Added	Result	Units	Yield	Control Limits	Flag
Th-229	4.504	3.23	pCi/g	71.6	30 - 110 %	

### Comments:

#### Qualifiers/Flags:

U - Result is less than the sample specific MDC.  
LT - Result is less than Requested MDC, greater than sample specific MDC.  
Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.  
Y2 - Chemical Yield outside default limits.  
L - LCS Recovery below lower control limit.  
H - LCS Recovery above upper control limit.  
P - LCS Recovery within control limits.  
M - The requested MDC was not met.  
M3 - The requested MDC was not met, but thereported activity is greater than the reported MDC.

#### Abbreviations:

TPU - Total Propagated Uncertainty (see PAI SOP 743)  
MDC - Minimum Detectable Concentration (see PAI SOP 709)

Data Package ID: TH0404284-1

# Isotopic Thorium By Alpha Spectroscopy

PAI 714 Rev 8

## Duplicate Sample Results (DER)

Lab Name: Paragon Analytics

Work Order Number: 0404284

Client Name: New Horizons

ClientProject ID: CSMRI 2135

Field ID: H-10-2  
Lab ID: 0404284-3DUPrep2

Sample Matrix: SOIL  
Prep SOP: PAI 777 Rev 7  
Date Collected: 26-Apr-04  
Date Prepared: 20-May-04  
Date Analyzed: 02-Jun-04

Prep Batch: AS040520-5  
QCBatchID: AS040520-5-1  
Run ID: AS040523-2A  
Count Time: 300 minutes  
Report Basis: Dry Weight

Final Aliquot: 0.104 g  
Prep Basis: Dry Weight  
Moisture(%): NA  
Result Units: pCi/g  
File Name: TR5205D2

CASNO	Analyte	Sample Result +/- 2s TPU	Duplicate Result +/- 2s TPU	DER	Control Limit	Lab Qualifiers
14274-82-9	Th-228	3.9 +/- 1.3	4.8 +/- 1.6	0.41	2.13	M3
14269-63-7	Th-230	165 +/- 28	196 +/- 34	0.71	2.13	M3
7440-29-1	Th-232	1.33 +/- 0.64	1.64 +/- 0.75	0.32	2.13	M3

### Comments:

#### Duplicate Qualifiers/Flags:

- U - Result is less than the sample specific MDC.
- Y1 - Chemical Yield is in control at 100-110%. Quantitative yield is assumed.
- Y2 - Chemical Yield outside default limits.
- W - DER is greater than Warning Limit of 1.42
- D - DER is greater than Control Limit of 2.13
- LT - Result is less than Request MDC, greater than sample specific MDC
- M - Requested MDC not met.
- M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.
- L - LCS Recovery below lower control limit.
- H - LCS Recovery above upper control limit.
- P - LCS, Matrix Spike Recovery within control limits.
- N - Matrix Spike Recovery outside control limits

#### Abbreviations:

- TPU - Total Propagated Uncertainty (see PAI SOP 743)
- DER - Duplicate Error Ratio
- BDL - Below Detection Limit
- NR - Not Reported

Data Package ID: TH0404284-1

# Isotopic Thorium By Alpha Spectroscopy

PAI 714 Rev 8  
Sample Results

Lab Name: Paragon Analytics

Work Order Number: 0404284

Client Name: New Horizons

ClientProject ID: CSMRI 2135

<b>Field ID:</b> Area I Bottom <b>Lab ID:</b> 0404284-1	<b>Sample Matrix:</b> SOIL <b>Prep SOP:</b> PAI 777 Rev 7 <b>Date Collected:</b> 27-Apr-04 <b>Date Prepared:</b> 20-May-04 <b>Date Analyzed:</b> 28-May-04	<b>Prep Batch:</b> AS040520-4 <b>QCBatchID:</b> AS040520-4-1 <b>Run ID:</b> AS040520-4A <b>Count Time:</b> 300 minutes <b>Report Basis:</b> Dry Weight	<b>Final Aliquot:</b> 1.02 g <b>Prep Basis:</b> Dry Weight <b>Moisture(%):</b> NA <b>Result Units:</b> pCi/g <b>File Name:</b> T42841
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CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Lab Qualifier
14274-82-9	Th-228	3.00 +/- 0.59	0.11	M3
14269-63-7	Th-230	23.6 +/- 4.0	0.2	M3
7440-29-1	Th-232	2.77 +/- 0.55	0.06	

## Chemical Yield Summary

Carrier/Tracer	Amount Added	Result	Units	Yield	Control Limits	Flag
Th-229	4.434	2.83	pCi/g	63.8	30 - 110 %	

## Comments:

### Qualifiers/Flags:

- U - Result is less than the sample specific MDC.
- Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.
- Y2 - Chemical Yield outside default limits.
- LT - Result is less than Requested MDC, greater than sample specific MDC.
- M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.
- M - The requested MDC was not met.

### Abbreviations:

- TPU - Total Propagated Uncertainty (see PAI SOP 743)
- MDC - Minimum Detectable Concentration (see PAI SOP 709)
- BDL - Below Detection Limit

Data Package ID: TH0404284-1



# Isotopic Thorium By Alpha Spectroscopy

PAI 714 Rev 8  
Sample Results

Lab Name: Paragon Analytics  
Work Order Number: 0404284  
Client Name: New Horizons  
ClientProject ID: CSMRI 2135

Field ID: Area K Bottom  
Lab ID: 0404284-2

Sample Matrix: SOIL  
Prep SOP: PAI 777 Rev 7  
Date Collected: 28-Apr-04  
Date Prepared: 20-May-04  
Date Analyzed: 28-May-04

Prep Batch: AS040520-4  
QC Batch ID: AS040520-4-1  
Run ID: AS040520-4A  
Count Time: 300 minutes  
Report Basis: Dry Weight

Final Aliquot: 2.00 g  
Prep Basis: Dry Weight  
Moisture(%): NA  
Result Units: pCi/g  
File Name: T42842

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Lab Qualifier
14274-82-9	Th-228	1.74 +/- 0.35	0.07	
14269-63-7	Th-230	14.8 +/- 2.6	0.1	
7440-29-1	Th-232	1.64 +/- 0.33	0.03	

## Chemical Yield Summary

Carrier/Tracer	Amount Added	Result	Units	Yield	Control Limits	Flag
Th-229	2.251	1.34	pCi/g	59.6	30 - 110 %	

### Comments:

#### Qualifiers/Flags:

- U - Result is less than the sample specific MDC.
- Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.
- Y2 - Chemical Yield outside default limits.
- LT - Result is less than Requested MDC, greater than sample specific MDC.
- M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.
- M - The requested MDC was not met.

#### Abbreviations:

- TPU - Total Propagated Uncertainty (see PAI SOP 743)
- MDC - Minimum Detectable Concentration (see PAI SOP 709)
- BDL - Below Detection Limit

Data Package ID: TH0404284-1

# Isotopic Thorium By Alpha Spectroscopy

## PAI 714 Rev 8 Sample Results

Lab Name: Paragon Analytics

Work Order Number: 0404284

Client Name: New Horizons

ClientProject ID: CSMRI 2135

Field ID: H-10-2  
Lab ID: 0404284-3REP2

Sample Matrix: SOIL  
Prep SOP: PAI 777 Rev 7  
Date Collected: 26-Apr-04  
Date Prepared: 20-May-04  
Date Analyzed: 28-May-04

Prep Batch: AS040520-5  
QCBatchID: AS040520-5-1  
Run ID: AS040523-2A  
Count Time: 300 minutes  
Report Basis: Dry Weight

Final Aliquot: 0.104 g  
Prep Basis: Dry Weight  
Moisture(%): NA  
Result Units: pCi/g  
File Name: T205R2

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Lab Qualifier
14274-82-9	Th-228	3.9 +/- 1.3	1.3	M3
14269-63-7	Th-230	165 +/- 28	1	M3
7440-29-1	Th-232	1.33 +/- 0.64	0.41	M3

### Chemical Yield Summary

Carrier/Tracer	Amount Added	Result	Units	Yield	Control Limits	Flag
Th-229	43.52	32.2	pCi/g	74.0	30 - 110 %	

### Comments:

#### Qualifiers/Flags:

- U - Result is less than the sample specific MDC.
- Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.
- Y2 - Chemical Yield outside default limits.
- LT - Result is less than Requested MDC, greater than sample specific MDC.
- M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.
- M - The requested MDC was not met.

#### Abbreviations:

- TPU - Total Propagated Uncertainty (see PAI SOP 743)
- MDC - Minimum Detectable Concentration (see PAI SOP 709)
- BDL - Below Detection Limit

Data Package ID: TH0404284-1

# Isotopic Thorium By Alpha Spectroscopy

PAI 714 Rev 8

## Sample Duplicate Results

Lab Name: Paragon Analytics

Work Order Number: 0404284

Client Name: New Horizons

ClientProject ID: CSMRI 2135

<b>Field ID:</b> H-10-2	<b>Sample Matrix:</b> SOIL	<b>Prep Batch:</b> AS040520-5	<b>Final Aliquot:</b> 0.104 g
<b>Lab ID:</b> 0404284-3DUPrep2	<b>Prep SOP:</b> PAI 777 Rev 7	<b>QCBatchID:</b> AS040520-5-1	<b>Prep Basis:</b> Dry Weight
	<b>Date Collected:</b> 26-Apr-04	<b>Run ID:</b> AS040523-2A	<b>Moisture(%):</b> NA
	<b>Date Prepared:</b> 20-May-04	<b>Count Time:</b> 300 minutes	<b>Result Units:</b> pCi/g
	<b>Date Analyzed:</b> 02-Jun-04	<b>Report Basis:</b> Dry Weight	<b>File Name:</b> TR5205D2

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Lab Qualifier
14274-82-9	Th-228	4.8 +/- 1.6	1.7	M3
14269-63-7	Th-230	196 +/- 34	2	M3
7440-29-1	Th-232	1.64 +/- 0.75	0.51	M3

## Chemical Yield Summary

Carrier/Tracer	Amount Added	Result	Units	Yield	Control Limits	Flag
Th-229	43.27	27.5	pCi/g	63.5	30 - 110 %	

## Comments:

### Qualifiers/Flags:

- U - Result is less than the sample specific MDC.
- Y1 - Chemical Yield is in control at 100-110%. Quantitative yield is assumed.
- Y2 - Chemical Yield outside default limits.
- LT - Result is less than Requested MDC, greater than sample specific MDC.
- M - The requested MDC was not met.
- M3 - The requested MDC was not met, but thereported activity is greater than the reported MDC.
- W - DER is greater than Warning Limit of 1.42
- D - DER is greater than Control Limit of 2.13

### Abbreviations:

- TPU - Total Propagated Uncertainty (see PAI SOP 743)
- MDC - Minimum Detectable Concentration (see PAI SOP 709)
- BDL - Below Detection Limit

Data Package ID: TH0404284-1