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\*\*\*\*\* G A M M A S P E C T R U M A N A L Y S I S \*\*\*\*\*  
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Filename: C:\GENIE2K\CAMFILES\UNC 2017\IMC Samples\IMC-2198\UNC-IMC-219

Report Generated On : 5/4/2017 8:08:35 AM

Sample Title : UNC-IMC-2198-S-P-5  
Sample Description :  
Sample Identification : IMC-2198-S-P-5  
Sample Type :  
Sample Geometry : cylinder

Peak Locate Threshold : 3.00  
Peak Locate Range (in channels) : 40 - 8192  
Peak Area Range (in channels) : 40 - 8192  
Identification Energy Tolerance : 1.000 keV

Sample Size : 5.796E+002 grams

Sample Taken On : 4/10/2017 12:00:00 AM  
Acquisition Started : 4/21/2017 8:50:13 AM

Live Time : 1800.0 seconds  
Real Time : 1800.7 seconds

Dead Time : 0.04 %

Energy Calibration Used Done On : 4/13/2017  
Efficiency Calibration Used Done On : 5/4/2017  
Efficiency ID : H-IMC-2189-S-P-5

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\*\*\*\*\* P E A K A N A L Y S I S R E P O R T \*\*\*\*\*  
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Detector Name: 8566

Sample Title: UNC-IMC-2198-S-P-5

Peak Analysis Performed on: 5/4/2017 8:08:29 AM

Peak Analysis From Channel: 40

Peak Analysis To Channel: 8192

|   | Peak<br>No. | ROI<br>start | ROI<br>end | Peak<br>centroid | Energy<br>(keV) | FWHM<br>(keV) | Net Peak<br>Area | Net Area<br>Uncert. | Continuum<br>Counts |
|---|-------------|--------------|------------|------------------|-----------------|---------------|------------------|---------------------|---------------------|
| F | 1           | 59-          | 71         | 65.07            | 16.39           | 0.83          | 6.07E+002        | 152.39              | 3.19E+002           |
| F | 2           | 93-          | 108        | 102.83           | 25.84           | 0.65          | 1.81E+002        | 90.17               | 2.40E+002           |
| F | 3           | 206-         | 221        | 213.11           | 53.44           | 0.67          | 2.33E+002        | 99.19               | 3.17E+002           |
| M | 4           | 288-         | 314        | 290.99           | 72.93           | 0.80          | 1.84E+002        | 72.08               | 3.29E+002           |
| m | 5           | 288-         | 314        | 299.43           | 75.04           | 0.81          | 4.22E+002        | 128.58              | 5.52E+002           |
| m | 6           | 288-         | 314        | 308.25           | 77.25           | 0.81          | 1.98E+002        | 66.03               | 5.18E+002           |
| M | 7           | 320-         | 344        | 324.97           | 81.43           | 0.83          | 1.09E+002        | 31.15               | 3.77E+002           |
| m | 8           | 320-         | 344        | 337.17           | 84.49           | 0.84          | 6.35E+002        | 53.75               | 6.70E+002           |
| F | 9           | 354-         | 365        | 359.78           | 90.14           | 0.63          | 2.60E+002        | 40.18               | 4.22E+002           |
| F | 10          | 366-         | 380        | 373.15           | 93.49           | 0.95          | 4.38E+002        | 180.11              | 5.35E+002           |
| F | 11          | 429-         | 441        | 436.64           | 109.38          | 0.60          | 1.66E+002        | 121.33              | 4.03E+002           |
| F | 12          | 479-         | 492        | 483.21           | 121.03          | 0.72          | 1.12E+002        | 31.40               | 4.25E+002           |
| F | 13          | 569-         | 580        | 574.44           | 143.86          | 0.87          | 8.90E+002        | 58.27               | 2.64E+002           |
| F | 14          | 647-         | 660        | 652.54           | 163.40          | 0.86          | 3.68E+002        | 34.36               | 2.66E+002           |
| F | 15          | 735-         | 749        | 741.78           | 185.74          | 0.97          | 4.32E+003        | 223.22              | 2.29E+002           |
| F | 16          | 774-         | 783        | 778.47           | 194.92          | 0.69          | 2.93E+001        | 17.26               | 8.25E+001           |
| M | 17          | 802-         | 829        | 807.31           | 202.14          | 0.94          | 4.74E+001        | 18.98               | 8.84E+001           |
| m | 18          | 802-         | 829        | 820.10           | 205.34          | 0.95          | 3.50E+002        | 36.69               | 1.00E+002           |
| F | 19          | 948-         | 959        | 952.79           | 238.54          | 0.90          | 1.76E+002        | 28.64               | 8.55E+001           |
| F | 20          | 1173-        | 1184       | 1178.66          | 295.06          | 0.73          | 6.25E+001        | 19.56               | 6.24E+001           |
| F | 21          | 1346-        | 1355       | 1350.83          | 338.15          | 0.90          | 3.08E+001        | 15.06               | 3.30E+001           |
| F | 22          | 1397-        | 1411       | 1404.90          | 351.68          | 1.05          | 1.27E+002        | 64.99               | 4.35E+001           |
| F | 23          | 2030-        | 2045       | 2037.81          | 510.06          | 1.64          | 6.03E+001        | 19.35               | 4.93E+001           |
| F | 24          | 2321-        | 2335       | 2328.16          | 582.72          | 1.46          | 7.39E+001        | 20.13               | 3.63E+001           |
| F | 25          | 2423-        | 2441       | 2432.63          | 608.86          | 1.59          | 7.66E+001        | 19.28               | 2.69E+001           |
| F | 26          | 5824-        | 5848       | 5836.42          | 1460.64         | 2.54          | 2.15E+002        | 29.79               | 9.72E+000           |

M = First peak in a multiplet region

m = Other peak in a multiplet region

F = Fitted singlet

Errors quoted at 1.960 sigma

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 \*\*\*\*\* N U C L I D E I D E N T I F I C A T I O N R E P O R T \*\*\*\*\*  
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Sample Title: UNC-IMC-2198-S-P-5  
 Nuclide Library Used: C:\GENIE2K\CAMFILES\GE\_UNC\_U-NLB.NLB

..... IDENTIFIED NUCLIDES .....

| Nuclide<br>Name | Id<br>Confidence | Energy<br>(keV) | Yield<br>(%) | Activity<br>(pCi/gram) | Activity<br>Uncertainty |
|-----------------|------------------|-----------------|--------------|------------------------|-------------------------|
| K-40            | 0.995            | 1460.82*        | 10.66        | 7.20559E+000           | 1.17202E+000            |
| U-234           | 0.992            | 53.20*          | 0.12         | 2.16349E+002           | 1.05843E+002            |
|                 |                  | 120.90*         | 0.04         | 1.58497E+002           | 7.01831E+001            |
| U-235           | 0.999            | 105.60          | 1.31         |                        |                         |
|                 |                  | 109.19*         | 1.66         | 5.01661E+000           | 3.88318E+000            |
|                 |                  | 143.76*         | 10.96        | 4.13813E+000           | 8.61391E-001            |
|                 |                  | 163.36*         | 5.08         | 3.87185E+000           | 8.09177E-001            |
|                 |                  | 202.12*         | 1.08         | 2.66450E+000           | 1.15209E+000            |
|                 |                  | 205.32*         | 5.02         | 4.28628E+000           | 8.14581E-001            |

\* = Energy line found in the spectrum.

@ = Energy line not used for Weighted Mean Activity

Energy Tolerance : 1.000 keV

Nuclide confidence index threshold = 0.10

Errors quoted at 1.960 sigma

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\*\*\*\*\* I N T E R F E R E N C E   C O R R E C T E D   R E P O R T   \*\*\*\*\*  
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| Nuclide<br>Name | Nuclide<br>Id<br>Confidence | Wt mean<br>Activity<br>(pCi/gram) | Wt mean<br>Activity<br>Uncertainty |
|-----------------|-----------------------------|-----------------------------------|------------------------------------|
| K-40            | 0.995                       | 7.205592E+000                     | 1.172017E+000                      |
| U-234           | 0.992                       | 1.761649E+002                     | 5.849234E+001                      |
| U-235           | 0.999                       | 3.900638E+000                     | 4.384549E-001                      |

? = nuclide is part of an undetermined solution  
X = nuclide rejected by the interference analysis  
@ = nuclide contains energy lines not used in Weighted Mean Activity

Errors quoted at 1.960 sigma

## \*\*\*\*\* U N I D E N T I F I E D P E A K S \*\*\*\*\*

Peak Locate Performed on: 5/4/2017 8:08:29 AM  
Peak Locate From Channel: 40  
Peak Locate To Channel: 8192

|   | Peak<br>No. | Energy<br>(keV) | Peak Size in<br>Counts per Second | Peak CPS<br>% Uncertainty | Peak<br>Type | Tol.<br>Nuclide |
|---|-------------|-----------------|-----------------------------------|---------------------------|--------------|-----------------|
| F | 1           | 16.39           | 3.3719E-001                       | 25.11                     |              |                 |
| F | 2           | 25.84           | 1.0076E-001                       | 49.72                     |              |                 |
| M | 4           | 72.93           | 1.0213E-001                       | 39.21                     |              |                 |
| m | 5           | 75.04           | 2.3428E-001                       | 30.49                     |              |                 |
| m | 6           | 77.25           | 1.1010E-001                       | 33.31                     |              |                 |
| M | 7           | 81.43           | 6.0716E-002                       | 28.50                     |              |                 |
| m | 8           | 84.49           | 3.5272E-001                       | 8.47                      |              |                 |
| F | 9           | 90.14           | 1.4471E-001                       | 15.43                     |              |                 |
| F | 10          | 93.49           | 2.4360E-001                       | 41.08                     |              |                 |
| F | 15          | 185.74          | 2.3982E+000                       | 5.17                      |              |                 |
| F | 16          | 194.92          | 1.6303E-002                       | 58.83                     |              |                 |
| F | 19          | 238.54          | 9.7567E-002                       | 16.31                     |              |                 |
| F | 20          | 295.06          | 3.4724E-002                       | 31.30                     |              |                 |
| F | 21          | 338.15          | 1.7105E-002                       | 48.91                     |              |                 |
| F | 22          | 351.68          | 7.0472E-002                       | 51.23                     |              |                 |
| F | 23          | 510.06          | 3.3476E-002                       | 32.11                     |              |                 |
| F | 24          | 582.72          | 4.1079E-002                       | 27.22                     |              |                 |
| F | 25          | 608.86          | 4.2541E-002                       | 25.18                     |              |                 |

M = First peak in a multiplet region

m = Other peak in a multiplet region

F = Fitted singlet

Errors quoted at 1.960 sigma

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 \*\*\*\*\* N U C L I D E M D A R E P O R T \*\*\*\*\*  
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Detector Name: 8566  
 Sample Geometry: cylinder  
 Sample Title: UNC-IMC-2198-S-P-5  
 Nuclide Library Used: C:\GENIE2K\CAMFILES\GE\_UNC\_U-NLB.NLB

|   | Nuclide Name | Energy (keV) | Yield (%) | Line MDA (pCi/gram) | Nuclide MDA (pCi/gram) | Activity (pCi/gram) | Dec. Leve (pCi/gram) |
|---|--------------|--------------|-----------|---------------------|------------------------|---------------------|----------------------|
| + | K-40         | 1460.82*     | 10.66     | 6.223E-001          | 6.22E-001              | 7.206E+000          | 2.658E-00            |
|   | PA-234       | 742.81       | 0.11      | 7.748E+001          | 1.21E+001              | -4.321E+001         | 3.613E+00            |
|   |              | 766.42       | 0.32      | 3.168E+001          |                        | 2.312E+001          | 1.494E+00            |
|   |              | 1001.03      | 0.84      | 1.206E+001          |                        | -4.901E-001         | 5.605E+00            |
|   | TH-234       | 63.29        | 3.70      | 2.567E+000          | 2.57E+000              | 2.761E+000          | 1.253E+00            |
|   |              | 92.38        | 2.13      | 4.483E+000          |                        | 1.773E+001          | 2.207E+00            |
|   |              | 92.80        | 2.10      | 4.377E+000          |                        | 3.338E+000          | 2.154E+00            |
|   |              | 112.81       | 0.21      | 3.057E+001          |                        | -9.528E+000         | 1.496E+00            |
| + | U-234        | 53.20*       | 0.12      | 1.067E+002          | 1.07E+002              | 2.163E+002          | 5.211E+00            |
|   |              | 120.90*      | 0.04      | 1.637E+002          |                        | 1.585E+002          | 7.993E+00            |
| + | U-235        | 105.60       | 1.31      | 5.292E+000          | 4.06E-001              | 3.164E+000          | 2.594E+00            |
|   |              | 109.19*      | 1.66      | 3.644E+000          |                        | 5.017E+000          | 1.781E+00            |
|   |              | 143.76*      | 10.96     | 4.056E-001          |                        | 4.138E+000          | 1.965E-00            |
|   |              | 163.36*      | 5.08      | 9.657E-001          |                        | 3.872E+000          | 4.686E-00            |
|   |              | 202.12*      | 1.08      | 2.614E+000          |                        | 2.664E+000          | 1.231E+00            |
|   |              | 205.32*      | 5.02      | 6.028E-001          |                        | 4.286E+000          | 2.848E-00            |

+ = Nuclide identified during the nuclide identification

\* = Energy line found in the spectrum

> = MDA value not calculated

@ = Half-life too short to be able to perform the decay correction

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 \*\*\* LINE ACTIVITY CONSISTENCY EVALUATOR \*\*\*  
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Analysis using Key Line Activities

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Filename: C:\GENIE2K\CAMFILES\UNC 2017\IMC Samples\IMC-2198\UNC-IMC-219

Equation used to calculate plot:  $\ln(\text{Ratio}) = A + B \cdot \ln(\text{Energy})$   
 where: Ratio = Activity/KL Activity

Notes:

'^' Denotes Key Line energy

\* All uncertainties quoted at 1.96 sigma

| Nuclide | Energy<br>(keV) |   | Activity<br>(pCi/gram) | Activity<br>%Uncert* | Ratio[%Uncert] | A     | B<br>[uncert] |
|---------|-----------------|---|------------------------|----------------------|----------------|-------|---------------|
| -----   | -----           |   | -----                  | -----                | -----          | ----- | -----         |
| K-40    | 1460.8          | ^ | 7.21E+000              | 16.265               |                |       |               |
| U-234   | 53.2            | ^ | 2.16E+002              | 48.922               | 1.000[69.187]  | 1.51  | -0.379        |
|         | 120.9           |   | 1.58E+002              | 44.281               | 0.733[65.986]  |       | [ 1.165]      |
| U-235   | 109.2           |   | 5.02E+000              | 77.406               | 1.212[80.156]  | 1.41  | -0.283        |
|         | 143.8           | ^ | 4.14E+000              | 20.816               | 1.000[29.438]  |       | [ 0.903]      |
|         | 163.4           |   | 3.87E+000              | 20.899               | 0.936[29.497]  |       |               |
|         | 202.1           |   | 2.66E+000              | 43.239               | 0.644[47.988]  |       |               |
|         | 205.3           |   | 4.29E+000              | 19.004               | 1.036[28.186]  |       |               |