DATA ANALYSIS

**Efficiency calculations:**

|  |  |  |  |
| --- | --- | --- | --- |
| N\_ref (120 kev peak) |  | I\_ref |  |
| 19458.1 | 148.52 | 28.37 | 0.13 |
| 33304.5 | 148.52 | 28.37 | 0.13 |
| 43399.7 | 227.815 | 28.37 | 0.13 |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Day 1 and Day 2: |  | Day 3: |  |  |  |
| N\_i |  | N\_i |  | I\_i |  |
| 4754.74 | 84.59 | 6363.96 | 100.319 | 7.53 | 0.04 |
| 11587.8 | 115.705 | 15362.8 | 134.584 | 26.57 | 0.11 |
| 421.276 | 51.06 | 667.661 | 57.608 | 3.125 | 0.014 |
| 910.91 | 63.36 | 845.467 | 67.15 | 12.97 | 0.06 |
| 1669.06 | 52.068 | 1938.36 | 58.15 | 14.63 | 0.06 |
| 887.99 | 42.45 | 1052.93 | 51.22 | 10.13 | 0.05 |
| 1283.13 | 47.27 | 1358.98 | 55.68 | 13.54 | 0.06 |
| 1738.67 | 43.16 | 2183.7 | 49.48 | 20.85 | 0.09 |

Table 1: Intensities and number of counts used for relative efficiency calculations

Europium Efficiencies:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Day 1: |  | Day 2: |  | Day 3: |  |
| Gamma energy/Channel | Efficiency |  | Efficiency |  | Efficiency |  |
| 244.697 kev | 0.557184 | 0.013648 | 0.537883 | 0.0105624 | 0.552465 | 0.0099637 |
| 344.279 kev | 0.374191 | 0.006016 | 0.371506 | 0.0046657 | 0.377965 | 0.0045109 |
| 443.965 kev | 0.218429 | 0.016414 | 0.114835 | 0.0139472 | 0.139662 | 0.0121059 |
| 778.821 kev | 0.0943952 | 0.004872 | 0.059826 | 0.0041880 | 0.042612 | 0.0034031 |
| 964.079 kev | 0.0909016 | 0.003942 | 0.0971816 | 0.0031203 | 0.086162 | 0.00269 |
| 1085.87 kev | 0.0746734 | 0.004773 | 0.0746715 | 0.0038526 | 0.067946 | 0.0033557 |
| 1112.07 kev | 0.0707218 | 0.003900 | 0.0807251 | 0.0030395 | 0.002742 | 0.0027422 |
| 1408.01 kev | 0.0702751 | 0.002392 | 0.0710342 | 0.0018465 | 0.001649 | 0.0016497 |
|  |  |  |  |  |  |  |

Table 2: Europium efficiencies

A graph with numbers and lines

Description automatically generated

Figure 2: Efficiency fit function Day -1

A graph of energy and data points

Description automatically generated

Figure 3: Efficiency fit function - Day 2

A graph of energy and data

Description automatically generated with medium confidence

Figure 4: Efficiency fit function - Day 3

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **Run** | **a** | **b** | **c** | **Energy Ranges** |
|  | Run 1 | 1.38049e-06 +/- 1.23416e-06 | -0.00265069 +/- 0.000839626 | 1.12314 +/- 0.14224 | 0-500 keV |
|  | Run 1 | -3.66794e-05 +/- 7.15112e-06 | 0.120163 +/- 0.00859698 | N/A | 750-1500 keV |
|  | Run 2 | -4.5368e-06 +/- 9.98605e-07 | 0.00100131 +/- 0.000672172 | 0.564514 +/- 0.112805 | 0-500 keV |
|  | Run 2 | -1.52647e-05 +/- 5.75405e-06 | 0.0945574 +/- 0.00697907 | N/A | 750-1500 keV |
|  | Run 3 | -3.20274e-06 +/- 9.11052e-07 | 0.000134008 +/- 0.000619206 | 0.711443 +/- 0.104704 | 0-500 keV |

Figure 4a: Coefficients and parameters for efficiency fit functions.



*Fig 4b. Fits used for 0-500 kev; 750-1500 kev.*

**Uranium:**

A graph of a number of electrons

Description automatically generated

Figure 5. Uranium Sample Spectrum.

A graph of a nuclear reaction

Description automatically generated with medium confidence

Figure 6. Uranium-238 Peak of 1001 kev gamma.

A graph of a nuclear reaction

Description automatically generated

*Figure 7. Uranium-235 Peak of 185 kev gamma.*

Decay constants:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Gamma energies  U-235:  1080-1105  Channel  U-238: 5280- 5340  Channel | Number of counts | Efficiencies | Branching ratios | Decay counts | Number of atoms | Isotopic ratio |
| Day 1: |  |  |  |  |  | 0.00276725 +/- 0.000047 |
| **U-235** |  |  |  |  |  |
| 185.715 kev | 61583.2 | 0.6784 | 57.2 +/- 0.9 | 1076.63 | 1.09252e12 |
| **U-238** |  |  |  |  |  |
| 1001.7 kev | 51559.6 | 0.0834 | 0.842 +/- 0.008 | 61234.7 | 3.94805e14 |
| Day 2: |  |  |  |  |  | 0.00282513 +/- 0.000030 |
| U-235 |  |  |  |  |  |
| 185.715 kev | 172023 | 0.593998 | 57.2 +/- 0.9 | 3007.39 | 3.05179e12 |
| **U-238** |  |  |  |  |  |
| 1001.7 kev | 141073 | 0.0792668 | 0.842 +/- 0.008 | 167545 | 1.08023e15 |
| Day 3: |  |  |  |  |  | 0.00242883 +/- 0.000032 |
| U-235 | 112132 | 0.625868 | 57.2 +/- 0.9 | 1960.36 | 1.9893e12 |
| 185.715 kev |  |  |  |  |  |
| U-238 | 107404 | 0.0664421 | 0.842 +/- 0.008 | 127558 | 8.22421e14 |
| 1001.7 kev |  |  |  |  |  |

Table 3: Uranium efficiencies and Isotopic abundance

**Equations Used for Isotopic and Uncertainty Calculation:**

**Data Analysis Updates and Fixes:**

* From the first analysis report the process of how we obtained the isotopic ratio didn’t change. The changes that were applied here were that we used the firestone tables and Nudat, to get the absolute intensities gamma (%) and that helped us to get more correct coefficient parameters and fitting. From there we did Isotopic Comparison for the U-235 185 kev gamma, and the U-238 1001.7 kev gamma and obtained the isotopic ratio that demonstrated that the source was indeed depleted. The error analysis we applied to our values goes like this we took the count uncertainties of the 2 reference peaks we chose made those values go through same isotopic abundance process to get specific number of atoms uncertainty and then applied propagation of error on (equation 7.) from above to get the uncertainty of isotopic ratio measurement.