

Supplementary material 1.

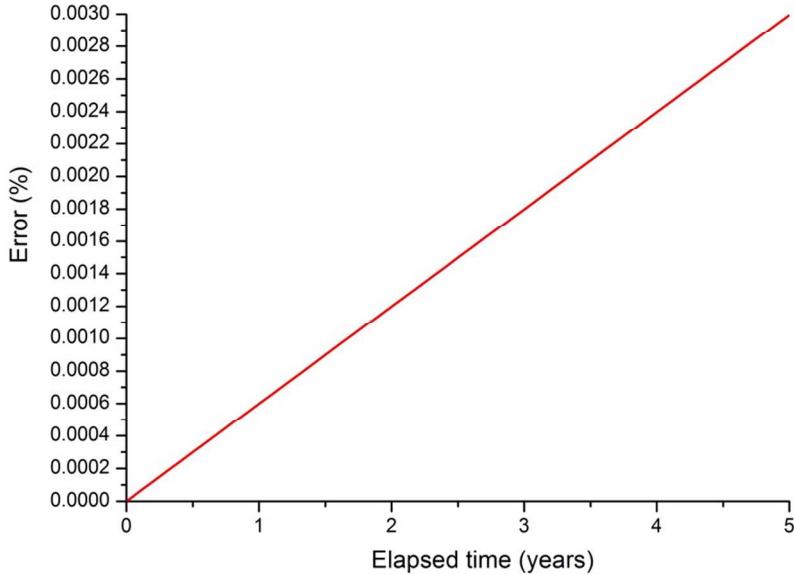
Approximation 1:

$$\left(e^{-\lambda_{U-234}t} - e^{-\lambda_{Th-230}t} \right) \approx t(\lambda_{Th-230} - \lambda_{U-234})$$

The error caused by the approximation (%):

$$Error(\%) = 1 - \frac{t(\lambda_{Th-230} - \lambda_{U-234})}{\left(e^{-\lambda_{U-234}t} - e^{-\lambda_{Th-230}t} \right)} \times 100$$

The approximation error (in %) as a function of time:



Approximation 2:

$$\frac{N_{Th-230}^0}{N_{U-234}(t)} = \frac{N_{Th-230}^0}{N_{U-234}^0 e^{-\lambda_{U-234}t}} = \frac{N_{Th-230}^0}{N_{U-234}^0 (1 - \lambda_{U-234}t)} \approx \frac{N_{Th-230}^0}{N_{U-234}^0}$$

since $\lambda_{U-234}t = 1.1 \times 10^{-5}$ (negligible) for $t = 4$ years using the DDEP half-life value (245500 ± 600 years).

Supplementary material 2.

ICP-MS and TIMS results of the purified HEU sample items

Separation step	^{234}U concentration by ICP-MS ($\mu\text{g g}^{-1}$)	^{234}U concentration by TIMS ($\mu\text{g g}^{-1}$)	Weighted average ($\mu\text{g g}^{-1}$)
1st separation	62.49 ± 0.22		62.49 ± 0.22
2nd separation		91.67 ± 0.23	91.67 ± 0.13
3rd separation	95.23 ± 0.41	95.09 ± 0.21	95.12 ± 0.23
4th separation	91.48 ± 0.23		91.48 ± 0.23
5th separation	93.89 ± 0.23	93.63 ± 0.21	93.75 ± 0.15
6th separation	92.81 ± 0.24	92.93 ± 0.21	92.88 ± 0.16