I. URANIUM THORIUM DATING

The decay chain:

\[ ^{238}\text{U} \rightarrow ^{234}\text{Th} \rightarrow ^{234}\text{Pa} \rightarrow ^{234}\text{U} \rightarrow ^{230}\text{Th} \]

The age of the sample is related to the number of \(^{238}\text{U}\), \(^{234}\text{U}\) and \(^{230}\text{Th}\), and is given by:

\[
\frac{^{230}\text{Th}}{^{238}\text{U}} = (1 - e^{-\lambda_{230} \cdot t}) + \frac{\lambda_{230}}{\lambda_{230} - \lambda_{234}} \left( \frac{^{234}\text{U}}{^{238}\text{U}} - 1 \right) (1 - e^{-(\lambda_{230} - \lambda_{234}) \cdot t})
\]

(1)

II. THERMOLUMINESCENCE DATING

\[ \text{Age} = \frac{\text{paleodose}}{\text{annual dose}} \]  

(2)

How to determine the paleodose?

Suppose the paleodose is \(N\). After \(\beta\) radiation, the dose is \(N + N_\beta\), then the ratio \(R\) is

\[ R = \frac{N}{N + N_\beta} \]

(3)

Thus the paleodose \(N\) is:

\[ N = \frac{N_\beta}{R^{-1} - 1} \]

(4)

How to determine the annual dose?

\[ D = D'_\alpha + D_\beta + D_\gamma \]

(5)

If the environment is wet, we have to correct for that:

\[ k_w^\alpha = \frac{k_d^\alpha}{1 + 1.5 \times f \times w} \]

(6)

\[ k_w^\beta = \frac{k_d^\beta}{1 + 1.25 \times f \times w} \]

(7)

\[ k_w^\gamma = \frac{k_d^\gamma}{1 + 1.14 \times f \times w} \]

(8)

With \(k^w/k^d\) the coefficients in the wet/dry environment. Then the annual dose is:

\[ D = k_w^\alpha D'_\alpha + k_w^\beta D_\beta + k_w^\gamma D_\gamma \]

(9)

The sunlight will decrease the paleodose in the antique. After being exposed for time \(t\), the paleodose is:

\[ TL(t) = TL(0) \times e^{-\kappa \cdot t} \]

(10)

with \(\kappa\) the material coefficient, \(t\) in unit of [hour].

OK, finally, let’s make some forgery! (Oh, just for fun, don’t sell it.)

\[ \text{FakeAge} = \frac{N + N_\gamma}{\text{annual dose}} \]

(11)

\[ N_\gamma = \frac{E}{m} \]  

(12)