**Geochronology and Thermochronology (Wiley site)**

*Errata to Geochronology and Thermochronology, 1st Edition, 2018*

Last updated 5 Nov 2019

**Chapter 1:**
- p. 12: Patterson’s original figure has a mistake in it: the dates associated with the A and B lines should be switched. This should be mentioned in the caption.

**Chapter 2:**
- p. 25, Figure 2.9: 40Ca and 40Ar labels are switched

**Chapter 5:**
- p. 83, eqn 5.9: “x” in denominator of RHS should be a “t”
- p. 86, section 5.1.6: first text line after eqn 5.18: should read “…where M has units of mass or moles per length.”
- p. 86, section 5.1.7: the squared on the mu in the numerator of the RHS should be squaring the parentheses, not just the mu.
- p. 86, section 5.1.7: ninth line from bottom of right-hand-column: the characteristic diffusion distance is sqrt(4Dt), not sqrt(2Dt).
- p. 87, section 5.1.7: Figure 5.4, y-axis label: Characteristic diffusion distance is (4Dt)^{1/2}, not (2Dt)^{1/2}.
- p. 89, Table 5.1, 8th equation down (second from bottom): the 6 at the beginning of the equation should be divided by pi-squared
- p. 96, caption to Fig. 5.13: Second sentence should read: “The equilibrium date (t_{eq}, equation 5.46) is approached quickly for higher temperature samples, resulting in a shallow temperature-date slope at greater depth, whereas reaching dates close to t_{eq} requires longer ingrowth times for lower temperatures and older dates, resulting in steep depth-date trends and shallow depths.”
- p. 96, equation 5.49: 1) On the RHS, there should be no prime symbol after the “t” in the denominator and at the end, in the “dt”. 2) On the RHS, the “T” in the numerator of the exponential should just be a “1”.
- p. 108, equation 5.90: The “y” in the numerator of the third term should be a “z”.
- p. 108, equation 5.91: All instances of “y” (one on LHS, and three on RHS) should be replaced with “z”.

**Chapter 8:**
- p. 190, See point for p. 12 in chapter 1.

**Chapter 10:**
• p. 277, equation 10.13: In the middle of the RHS, “\(^{238}\text{U}\!/^{235}\text{U}\)” should read “\(^{238}\text{U}\!/^{235}\text{U}\)”
• p. 277, equation 10.18: On RHS, the second “=” should be replaced by “·”

Chapter 11:

• p. 315: equation 11.16: RHS: there should not be a negative sign in front of the \(E\) in the exponential in the denominator.
• p. 322, Caption to Figure 11.28: Description of the right panel should be rewritten to say: “Right: model results for He ages of randomly selected fragments with varying length and number of original c-axis-perpendicular terminations of an apatite crystal with U and Th concentrations of 20 ppm that has experienced the “Wolf 5” thermal history of Wolf et al. (1998). The original grain had a length of 400 \(\mu\text{m}\), cylindrical radius of 75 \(\mu\text{m}\) and model age of ~38 Ma (grey square). Filled symbols represent ages of model fragments with one termination; open symbols represent those with no original terminations. Horizontal dashed lines: lower line is the mean age of fragments with one remaining termination; middle dashed line is mean of all fragments; second from top line is mean age of fragments with no remaining terminations; top line is maximum age of zero-termination grains. The wide range of possible ages from fragments of a single model apatite demonstrate one possible origin of age dispersion in grains with thermal histories involving prolonged residence in the apatite He partial retention zone. (Source: Brown et al. [2013]. Reproduced with permission of Elsevier.)”

Chapter 14:

• Table 14.1: initial ratio for Hf should be \(^{182}\text{Hf}/^{180}\text{Hf}\), not \(^{182}\text{Hf}/^{177}\text{Hf}\)

Clarification on the application of short-lived radioisotopes for dating early Solar System events – Page 423.

The various time-related subscripts used in equations 14.1 through 14.7 are not sufficiently clear in explaining the approach to isochron applications of short-lived radionuclides. To make this application clearer, consider a linear scale of time that begins when the first solids form in the Solar System. We will define this time as \(t_{\text{ss}}\), so \(t_{\text{ss}} = 0\) on this scale. Consider the case of meteorite A that forms some time after \(t_{\text{ss}}\). We will define the time of formation of this meteorite as \(t_A\). Meteorite A is then the subject of isotope analyses of its minerals at some later time that we will call \(t_m\). If \(t_m\) is today, then \(t_m = 4.567\) Ga on the time scale. On this scale, the absolute age of meteorite A with respect to the present day is \((t_m-t_A)\) and its relative age with respect to the beginning of the Solar System is \((t_A-t_{\text{ss}})\).

The standard radioactive decay equation for the Al-Mg system is then:

\[
(\text{Mg}/\text{Mg})_m = (\text{Mg}/\text{Mg})_A + (\text{Al}/\text{Mg})_m * (e^{\lambda x (t_m-t_A)} - 1)
\]

Where the \(t_m\) subscript means measured ratios and the \(t_A\) subscript means the value of the ratio when the meteorite formed at time = \(t_A\).
With short-lived isotope systems, at the present day \( (t_m) \) the parent has nearly completely decayed away, so \( \frac{^{26}\text{Al}}{^{24}\text{Mg}} \) \( t_m \) is very close to zero, and so cannot be measured precisely. For that reason, we expand this ratio as:

\[
\frac{^{26}\text{Al}}{^{24}\text{Mg}} \mid _t = \frac{^{26}\text{Al}}{^{27}\text{Al}} \mid _t \times \frac{^{27}\text{Al}}{^{24}\text{Mg}} \mid _t \tag{14.4}
\]

Because both \( ^{27}\text{Al} \) and \( ^{24}\text{Mg} \) are stable isotopes, \( \frac{^{27}\text{Al}}{^{24}\text{Mg}} \mid _t \) will be the same as \( \frac{^{27}\text{Al}}{^{24}\text{Mg}} \mid _A \) as long as no process (e.g. metamorphism, heating, etc.) has caused the Al/Mg concentration ratios in the minerals to change since the meteorite crystallized. To account for the radioactive decay of \( ^{26}\text{Al} \):

\[
\frac{^{26}\text{Al}}{^{27}\text{Al}} \mid _t = \frac{^{26}\text{Al}}{^{27}\text{Al}} \mid _A \times e^{-\lambda \times (t_m - t_A)}
\]

With these substitutions, the radioactive decay equation becomes:

\[
\frac{^{26}\text{Mg}}{^{24}\text{Mg}} \mid _t = \frac{^{26}\text{Mg}}{^{24}\text{Mg}} \mid _A + \frac{^{27}\text{Al}}{^{24}\text{Mg}} \mid _t \times \frac{^{26}\text{Al}}{^{27}\text{Al}} \mid _A \times [1 - e^{-\lambda \times (t_m - t_A)}] \tag{14.5}
\]

At the present day, the term \( e^{-\lambda \times (t_m - t_A)} \) is very close to zero, so a plot of the two measurable parameters in this equation, \( \frac{^{26}\text{Mg}}{^{24}\text{Mg}} \mid _t \) on the abscissa and \( \frac{^{27}\text{Al}}{^{24}\text{Mg}} \mid _t \) on the ordinate, gives a slope equal to \( \frac{^{26}\text{Al}}{^{27}\text{Al}} \mid _A \) and an intercept equal to \( \frac{^{26}\text{Mg}}{^{24}\text{Mg}} \mid _A \). For this reason, the slope of an isochron for short-lived systems does not give the age of the sample, but instead the abundance of the short-lived isotope relative to a stable isotope of the same element. To obtain the age of meteorite A requires comparing \( \frac{^{26}\text{Al}}{^{27}\text{Al}} \mid _A \) with some other material where it’s \( ^{26}\text{Al}/^{27}\text{Al} \) is known at some time. For example, if we know \( \frac{^{26}\text{Al}}{^{27}\text{Al}} \mid _{t_{ss}} \), then the age difference between meteorite A and \( t_{ss} \) is given by:

\[
\frac{^{26}\text{Al}}{^{27}\text{Al}} \mid _A = \frac{^{26}\text{Al}}{^{27}\text{Al}} \mid _{t_{ss}} \times e^{-\lambda \times (t_A - t_{ss})} \tag{14.6}
\]

So the age of the meteorite relative to \( t_{ss} \) is:

\[
(t_A - t_{ss}) = -\frac{1}{\lambda} \times \ln \left[ \frac{\frac{^{26}\text{Al}}{^{27}\text{Al}} \mid _A}{\frac{^{26}\text{Al}}{^{27}\text{Al}} \mid _{t_{ss}}} \right] \tag{14.7}
\]