Appendix

Stacey and Kramers (1975) determined modern-day crustal average Pb isotope ratios to be $^{206}Pb/^{204}Pb = 18.70$, $^{207}Pb/^{204}Pb = 15.63$, and $^{208}Pb/^{204}Pb = 38.63$, based on Pb isotopic data from "conformable" galena. They then fitted a two-stage Pb evolution curve, the second stage having $\mu = {}^{238}U/^{204}Pb = 9.74$. In practice, Pb_i ratios based on the Stacey and Kramers (1975) model can be calculated for materials younger than 3.7 Ga from equations 1 and 2 below, using the modern-day crustal average Pb isotope ratios and an approximate age (Stacey and Kramers model Pb ratios are superscipted SK).

$$\left(\frac{^{206}Pb}{^{204}Pb}\right)_i^{SK} = \left(\frac{^{206}Pb}{^{204}Pb}\right)_{today}^{SK} - m\left(e^{l_{238}t} - 1\right) \qquad [eq.1]$$

$$\left(\frac{^{207}Pb}{^{204}Pb}\right)_i^{SK} = \left(\frac{^{207}Pb}{^{204}Pb}\right)_{today}^{SK} - \frac{1}{137.82} m\left(e^{l_{235}t} - 1\right) \qquad [eq.2]$$

The 204 method initial Pb correction (Stern, 1997) subtracts the initial Pb fraction ($^{204c}f_{206}$), calculated using Stacey and Kramers (1975) Pb_i ratios, from the total measured $^{206}Pb/^{238}U$ to determine the radiogenic $^{206}Pb/^{238}U$ ratio.

$$^{204c}f_{206} = \frac{^{206}Pb_i}{^{206}Pb_{total}} = \frac{\left(^{204}Pb/^{206}Pb\right)_{measured}^{unknown}}{\left(^{204}Pb/^{206}Pb\right)_i^{SK}} \qquad [eq.3]$$

$$\left(\frac{^{206}Pb^{*}}{^{238}U}\right)^{unknown}_{corrected} = \left(1 - {}^{204c}f_{206}\right)\left(\frac{^{206}Pb}{^{238}U}\right)^{unknown}_{measured} \qquad [eq.4]$$

The 207 method Pb_i correction (Stern, 1997) subtracts the initial Pb fraction ($^{207c}f_{206}$), calculated using Stacey and Kramers (1975) Pb_i values and a starting guess or "expected" radiogenic $^{207}Pb/^{206}Pb$ ratio, from the total measured $^{207}Pb/^{206}Pb$ to determine the corrected radiogenic $^{207}Pb/^{206}Pb$ ratio.

$$^{207c}f_{206} = \frac{^{206}Pb_i}{^{206}Pb_{total}} = \frac{\left(\frac{^{206}Pb}{^{207}Pb}\right)^{unknown}_{measured} - \left(\frac{^{206}Pb^{*}}{^{207}Pb^{*}}\right)^{unknown}_{expected}}{\left(\frac{^{206}Pb}{^{207}Pb}\right)^{SK}_{i} - \left(\frac{^{206}Pb^{*}}{^{207}Pb^{*}}\right)^{unknown}_{expected}} \qquad [eq.5]$$

$$f_{207} = {}^{207c}f_{206}{}' \frac{\left(^{207}Pb/^{206}Pb\right)^{SK}_{i}}{\left(^{207}Pb/^{206}Pb\right)^{unknown}_{measured}} \qquad [eq.6]$$

$$\left(\frac{^{207}Pb^{*}}{^{206}Pb^{*}}\right)^{unknown}_{corrected} = \left(\frac{^{207}Pb}{^{206}Pb}\right)^{unknown}_{measured} \times \frac{\left(1 - f_{207}\right)}{\left(1 - {}^{207c}f_{206}\right)} \qquad [eq.7]$$