

Interactive comment on “On the treatment of discordant detrital zircon U–Pb data” by Pieter Vermeesch

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I would like to thank the reviewer for his positive review and his sharp eyes, which spotted a few errors that had escaped my attention. I will follow all his recommendations in the revised manuscript.

Line 35: I think the superscript “204” is not necessary

²⁰⁴Pb can be used in discordia regression. But to avoid confusion, I will change “²³⁸U–^{204,6,7}Pb space” to “U–Pb isotope space”.

Line 94: It requires another equation for the concordia age with 6/8 and 7/6
 C1

ratios.

The concordia age calculation can either be done in Wetherill space or in Tera Wasserburg space. The Wetherill version is simpler but I will follow the reviewer’s suggestion and replace Equation 1 with the Tera-Wasserburg formulation because the paper contains several Tera-Wasserburg concordia diagrams but no Wetherill diagram.

$$S = \begin{bmatrix} r_{86} - 1/R_{68}(t_c) \\ r_{76} - R_{58}R_{75}(t_c)/R_{68}(t_c) \end{bmatrix}^T \begin{bmatrix} \sigma[r_{86}]^2 & \sigma[r_{86}, r_{76}] \\ \sigma[r_{86}, r_{76}] & \sigma[r_{76}]^2 \end{bmatrix}^{-1} \begin{bmatrix} r_{86} - 1/R_{68}(t_c) \\ r_{76} - R_{58}R_{75}(t_c)/R_{68}(t_c) \end{bmatrix}$$

Line 101: It will be much clearer if you can list the six definitions for different discordance filters in a table.

I will add the requested table to the conclusions section:

definition	description	comment
$d_r = 1 - t_{68}/t_{76}$	relative age difference	biases against young samples
$d_{sk} = 1 - r_{86}/r_{86}^*$	fraction of common Pb	biases against old samples
$d_p = \text{Prob}(s > S S \sim \chi_2^2)$	p-value of concordance	biases against precise measurements
$d_t = t_{76} - t_{68}$	absolute age difference	allows negative ages
$d_a = dx(t_{68}) \sin\left(\arctan\left[\frac{dy(t_{76})}{dx(t_{68})}\right]\right)$	Aitchison distance	most strict for ‘middle age’
$d_c = \text{sgn}[t_{76} - t_{68}] \sqrt{dx(t_c)^2 + dy(t_c)^2}$	concordia distance	least biased

Figure 2: Is the concordia age (t_c) calculated by 6/8 and 7/6 ratios or 6/8 and 7/5 ratios?

See my response to the comment about line 94. t_c can be calculated using either set of ratios.

Figure 3: The top figure is good! But it will be better if you can give an envelope (above and below the concordia line) for each discordance filter because the discordance can be negative in nature. In contrast, the bottom figure is confusing in its present form. The absolute age filter (dt) may not be the best filter but it looks like a robust one in the figure.

I will follow the reviewer's suggestion and extend the envelope below the concordia line (see Figure 1). I will also remove the bottom panel. The absolute age filter may look unreasonable, but actually outperforms the relative age filter!

Figure 5: Are 0.84, 0.85 and 0.87 the intersections for the three lines? What do the arrows mean?

I have added an inset and removed the arrows to clarify the figure (Figure 2).

Figure 6: The axis values may not be in logarithmic space. The log (7/6) should be negative value as shown in Figure 3. It's better to add the label dx and dy for the dash lines.

Done (Figure 3).

Equation 7: $\exp(\lambda_{235}t) - 1$ and $\exp(\lambda_{238}t) - 1$ should be in parentheses.

The revised manuscript will introduce further shorthand notation to shorten the equations and remove the number of nested brackets:

$$d_a = dx(t_{68}) \sin\left(\arctan\left[\frac{dy(t_{76})}{dx(t_{68})}\right]\right)$$

C3

where

$$dx(t) = \ln[r_{86}] + \ln[R_{68}(t)] \quad \text{and} \quad dy(t) = \ln[r_{76}] - \ln\left[R_{58} \frac{R_{75}(t)}{R_{68}(t)}\right]$$

with $R_{68}(t) = \exp(\lambda_{238}t) - 1$, $R_{75}(t) = \exp(\lambda_{235}t) - 1$, and $R_{58} = {}^{235}\text{U}/{}^{238}\text{U}$.

Interactive comment on Geochronology Discuss., <https://doi.org/10.5194/gchron-2020-38>, 2020.

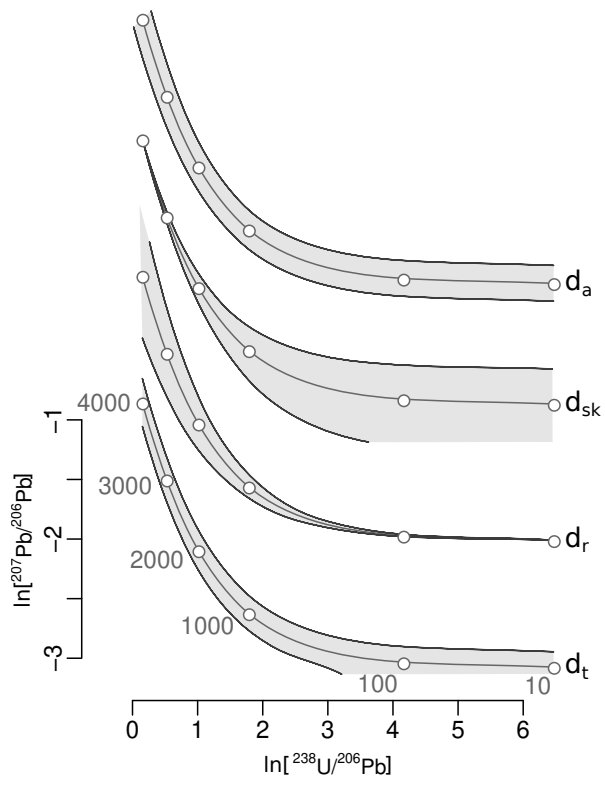


Fig. 1.

C5

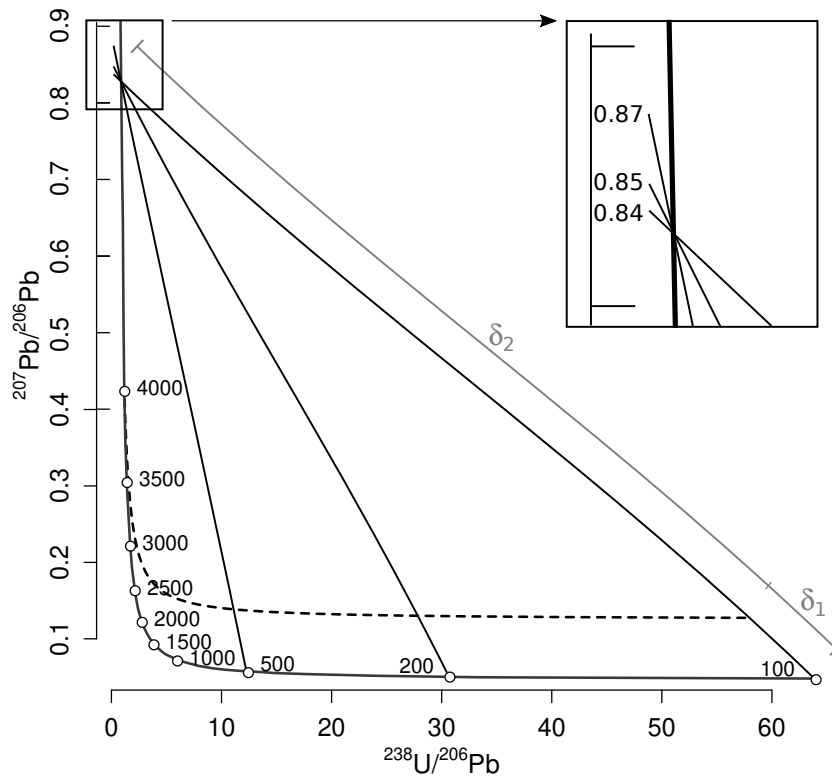


Fig. 2.

C6

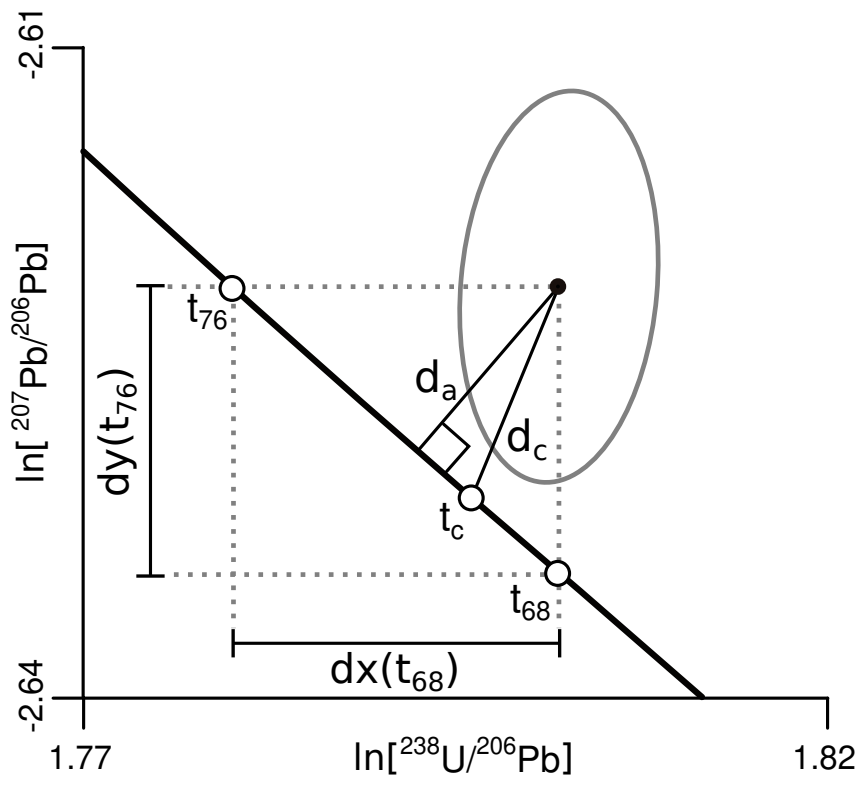


Fig. 3.