

Erratum

Crystal Growth and the Formation of Chemical Zoning in Garnets

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A correction to the isothermal exchange equilibrium fractionation model needs to be made. In attempting to derive a solution to Eq. (9) an algebraic mistake was carried through Appendix A and occurs in the final equations. Equation (A4) should be:

$$\frac{dW_R}{W_R} = \frac{M_R(1-K_D)-a}{M_R[M_R(K_D-1)-(K_D-a)]} dM_R \quad (\text{A4}')$$

or

$$\frac{dW_R}{W_R} = \frac{1-K_D}{M_R(K_D-1)-(K_D-a)} dM_R + \frac{a}{M_R[(K_D-a)-M_R(K_D-1)]} dM_R. \quad (\text{A5}')$$

Using partial fractions and defining a new term:

$$\alpha \equiv \frac{K_D-a}{K_D-1}$$

an easily integrated expression follows:

$$\int_{W^0}^{W_R} \frac{dW_R}{W_R} = - \int_{M_0}^{M_R} \frac{1}{M_R-\alpha} dM_R - \frac{a}{K_D-a} \int_{M_0}^{M_R} \frac{1}{M_R-\alpha} dM_R + \frac{a}{K_D-a} \int_{M_0}^{M_R} \frac{1}{M_R} dM_R \quad (\text{A6}')$$

which gives:

$$\ln \left(\frac{W_R}{W^0} \right) = - \ln \left(\frac{M_R-\alpha}{M_0-\alpha} \right) - \frac{a}{K_D-a} \ln \left(\frac{M_R-\alpha}{M_0-\alpha} \right) + \frac{a}{K_D-a} \ln \left(\frac{M_R}{M_0} \right). \quad (\text{A7}')$$

This leads to the correct solution of the isothermal exchange equilibrium equation:

$$\frac{W_R}{W^0} = \left(\frac{M_R-\alpha}{M_0-\alpha} \right)^{\frac{-K_D}{K_D-a}} \left(\frac{M_R}{M_0} \right)^{\frac{a}{K_D-a}}. \quad (\text{A8}') \text{ and } (\text{10}')$$

This equation can be rewritten in terms of the garnet weight and cation concentration to produce the correct fractionation model expressions:

$$1 - \frac{W^G}{W^0} = \left[\frac{K_D(M_G-\alpha)}{(K_D(1-M_G)+M_G)(M_0-\alpha)} \right]^{\frac{-K_D}{K_D-a}} \cdot \left[\frac{aM_G}{K_DM_0+M_GM_0(1-K_D)} \right]^{\frac{a}{K_D-a}} \quad (\text{13}')$$

or

$$f(M_G) = \left[\frac{K_D(M_G-\alpha)}{(K_D(1-M_G)+M_G)(M_0-\alpha)} \right]^{\frac{-K_D}{K_D-a}} \cdot \left[\frac{aM_G}{K_DM_0+M_GM_0(1-K_D)} \right]^{\frac{a}{K_D-a}} + \frac{W^G}{W^0} - 1 = 0. \quad (\text{14}')$$

These corrections do *not* affect the results presented in the original paper where the a parameter was set equal to one. In that situation the original and corrected equations are the same. The effect of varying the a parameter at constant λ was again analyzed with results similar to those discussed in the original paper. The value of a was reduced to as low as 0.25 to yield fractionation profiles which closely agree with the profiles obtained with a equal to one. Maximum concentration deviations are respectively 0.01 wt. % and 0.50 wt. % for a minor (e.g. $M_G^0 = 6.8$ wt. %) and major (e.g. $M_G^0 = 47$ wt. %) component. However, caution must be expressed in selecting the a parameter value for certain applications of the model to major component zoning requiring small K_D values, usually less than 10. These instances may produce significant deviations in concentration for non-unity a values.

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