Fe–Mg diffusion in olivine II: point defect chemistry, change of diffusion mechanisms and a model for calculation of diffusion coefficients in natural olivine

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The original version of this article unfortunately contained errors. The corrected equations is given below.

In Abstract

The three equations in the Abstract were reported incorrectly and should be changed as follows:

(1) At oxygen fugacities greater than 10^{-10} Pa:

Wrong equation:

$$\log [D_{\text{FeMg}}(m^2/s)] = -9.21 - \frac{201000 + (P - 10^5) \times 7 \times 10^{-6}}{2.303RT} + \frac{1}{6} \log(fO_2/10^{-7}) + 3X_{\text{Fe}}$$

Correct equation:

$$\log [D_{\text{FeMg}}(m^2/s)] = -9.21 - \frac{201000 + (P - 10^5) \times 7 \times 10^{-6}}{2.303RT} + \frac{1}{6} \log(fO_2/10^{-7}) + 3(X_{\text{Fe}} - 0.1)$$

where T is in Kelvin, P and fO_2 are in Pascals, X_{Fe} is the mole fraction of the fayalite component and R is the gas constant in J/mol K.

(2) At oxygen fugacities less than 10^{-10} Pa:

Wrong equation:

$$\log [D_{\text{FeMg}}(m^2/s)] = -8.91 - \frac{220000 + (P - 10^5) \times 7 \times 10^{-6}}{2.303RT} + 3X_{\text{Fe}}$$

Correct equation:

$$\log [D_{\text{FeMg}}(m^2/s)] = -8.91 - \frac{220000 + (P - 10^5) \times 7 \times 10^{-6}}{2.303RT} + 3(X_{\text{Fe}} - 0.1)$$

These equations reproduce all of the 113 experimental data points within half an order of magnitude.

(3) Alternatively, a global equation averaging out the change of mechanism may be used, with somewhat larger errors in reproducing the measured diffusion data. It underestimates data at higher temperatures, and overestimates them at lower temperatures on the average. Note that fO_2 is not explicitly considered here, leading to additional sources of error:

Wrong equation:

$$\log [D_{\text{FeMg}}(m^2/s)] = -8.27 - \frac{226000 + (P - 10^5) \times 7 \times 10^{-6}}{2.303RT} + 3X_{\text{Fe}}$$

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Correct equation:

$$\log [D_{\text{FeMg}}(m^2/s)] = -8.27 - \frac{226000 + (P - 10^5) \times 7 \times 10^{-6}}{2.303RT} + 3(X_{\text{Fe}} - 0.14)$$

To obtain diffusion coefficients along [100] and [010], log 6 needs to be subtracted from each of the above equations.

In Text, Section: “General Equation to describe Fe–Mg diffusion in natural olivine”

The following equations were reported incorrectly and should be changed as follows:

Equation 27:

Wrong equation:

$$\log D_{\text{FeMg}} = \log(D^\circ) - \frac{Q + (P - 10^5) \cdot \Delta V}{2.303RT} + \frac{1}{n} \log(f\text{O}_2/f\text{O}_2^\circ) + m \cdot X_{\text{Fe}} \quad (27)$$

Correct equation:

$$\log D_{\text{FeMg}} = \log(D^\circ) - \frac{Q + (P - 10^5) \cdot \Delta V}{2.303RT} + \frac{1}{n} \log(f\text{O}_2/f\text{O}_2^\circ) + m \cdot (X_{\text{Fe}} - 0.1) \quad (27)$$

Equation 28:

Wrong equation:

$$\log D_{\text{FeMg}} = \log(D^\circ) - \frac{Q + (P - 10^5) \cdot \Delta V}{2.303RT} + 3X_{\text{Fe}} \quad (28)$$

Correct equation:

$$\log D_{\text{FeMg}} = \log(D^\circ) - \frac{Q + (P - 10^5) \cdot \Delta V}{2.303RT} + 3(X_{\text{Fe}} - 0.1) \quad (28)$$

Equation 29:

Wrong equation:

$$\log D_{\text{FeMg}} = \log(D^\circ) - \frac{Q + (P - 10^5) \cdot \Delta V}{2.303RT} + 3X_{\text{Fe}} \quad (29)$$

Correct equation:

$$\log D_{\text{FeMg}} = \log(D^\circ) - \frac{Q + (P - 10^5) \cdot \Delta V}{2.303RT} + 3(X_{\text{Fe}} - 0.14) \quad (29)$$