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Coronal reaction textures in garnet amphibolites of the Llano Uplift

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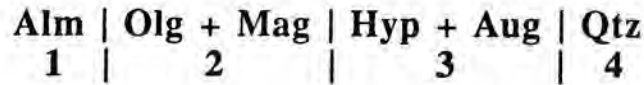
## EQUATIONS USED IN STEADY-DIFFUSION MODELS

[This table is intended for the data repository rather than for publication in the journal itself.]

In this table, notation follows that of Joesten (1977), as extended for boundary fluxes by Johnson and Carlson (1990). Superscripts identifying interfaces between layers (e.g. '2-3') refer to layer numbers indicated by a header at the beginning of each set of equations. Mineral abbreviations are as follows: : 'Alm' = almandine; 'Aug' = augite; 'Hbl' = magnesiohornblende; 'Hyp' = hypersthene and ferrohypersthene; 'Lab' = labradorite; 'Mag' = magnetite; ; 'Prg' = ferroan pargasite; 'Olg' = oligoclase; 'Omp' = omphacite; 'Qtz' = quartz.

In the boundary-flux equations, fluxes determined from the material balance have been assigned entirely to the outer boundary of the reaction band; i.e., the fluxes across the contact with the central garnet crystal have been taken as zero.

**EQUATIONS USED IN STEADY-DIFFUSION MODEL OF  
GARNET-QUARTZ CORONA**



**Material-Balance Equations**

$$v_{\text{SiO}_2}^{1-2} + 3.00 v_{\text{Alm}}^{1-2} + 2.75 v_{\text{Olg}}^{1-2} + 0.00 v_{\text{Mag}}^{1-2} = 0$$

$$v_{\text{AlO}_{3/2}}^{1-2} + 1.96 v_{\text{Alm}}^{1-2} + 1.25 v_{\text{Olg}}^{1-2} + 0.00 v_{\text{Mag}}^{1-2} = 0$$

$$v_{\text{FeO}}^{1-2} + 1.63 v_{\text{Alm}}^{1-2} + 0.00 v_{\text{Olg}}^{1-2} + 3.00 v_{\text{Mag}}^{1-2} = 0$$

$$v_{\text{MgO}}^{1-2} + 0.49 v_{\text{Alm}}^{1-2} + 0.00 v_{\text{Olg}}^{1-2} + 0.00 v_{\text{Mag}}^{1-2} = 0$$

$$v_{\text{CaO}}^{1-2} + 0.67 v_{\text{Alm}}^{1-2} + 0.25 v_{\text{Olg}}^{1-2} + 0.00 v_{\text{Mag}}^{1-2} = 0$$

$$v_{\text{SiO}_2}^{2-3} + 2.75 v_{\text{Olg}}^{2-3} + 0.00 v_{\text{Mag}}^{2-3} + 1.99 v_{\text{Hyp}}^{2-3} + 2.00 v_{\text{Aug}}^{2-3} = 0$$

$$v_{\text{AlO}_{3/2}}^{2-3} + 1.25 v_{\text{Olg}}^{2-3} + 0.00 v_{\text{Mag}}^{2-3} + 0.01 v_{\text{Hyp}}^{2-3} + 0.03 v_{\text{Aug}}^{2-3} = 0$$

$$v_{\text{FeO}}^{2-3} + 0.00 v_{\text{Olg}}^{2-3} + 3.00 v_{\text{Mag}}^{2-3} + 0.99 v_{\text{Hyp}}^{2-3} + 0.36 v_{\text{Aug}}^{2-3} = 0$$

$$v_{\text{MgO}}^{2-3} + 0.00 v_{\text{Olg}}^{2-3} + 0.00 v_{\text{Mag}}^{2-3} + 0.92 v_{\text{Hyp}}^{2-3} + 0.70 v_{\text{Aug}}^{2-3} = 0$$

$$v_{\text{CaO}}^{2-3} + 0.25 v_{\text{Olg}}^{2-3} + 0.00 v_{\text{Mag}}^{2-3} + 0.03 v_{\text{Hyp}}^{2-3} + 0.85 v_{\text{Aug}}^{2-3} = 0$$

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$$v_{\text{SiO}_2}^{3-4} + 1.99 v_{\text{Hyp}}^{3-4} + 2.00 v_{\text{Aug}}^{3-4} + 1.00 v_{\text{Qtz}}^{3-4} = 0$$

$$v_{\text{AlO}_{3/2}}^{3-4} + 0.01 v_{\text{Hyp}}^{3-4} + 0.03 v_{\text{Aug}}^{3-4} + 0.00 v_{\text{Qtz}}^{3-4} = 0$$

$$v_{\text{FeO}}^{3-4} + 0.99 v_{\text{Hyp}}^{3-4} + 0.36 v_{\text{Aug}}^{3-4} + 0.00 v_{\text{Qtz}}^{3-4} = 0$$

$$v_{\text{MgO}}^{3-4} + 0.92 v_{\text{Hyp}}^{3-4} + 0.70 v_{\text{Aug}}^{3-4} + 0.00 v_{\text{Qtz}}^{3-4} = 0$$

$$v_{\text{CaO}}^{3-4} + 0.03 v_{\text{Hyp}}^{3-4} + 0.85 v_{\text{Aug}}^{3-4} + 0.00 v_{\text{Qtz}}^{3-4} = 0$$

## Steady-Diffusion (Conservation) Equations

$$J_{\text{SiO}_2}^{\text{Alm}} + J_{\text{SiO}_2}^{\text{Olg}} + J_{\text{SiO}_2}^{\text{Mag}} + v_{\text{SiO}_2}^{1-2} = 0$$

$$J_{\text{AlO}_{3/2}}^{\text{Alm}} + J_{\text{AlO}_{3/2}}^{\text{Olg}} + J_{\text{AlO}_{3/2}}^{\text{Mag}} + v_{\text{AlO}_{3/2}}^{1-2} = 0$$

$$J_{\text{FeO}}^{\text{Alm}} + J_{\text{FeO}}^{\text{Olg}} + J_{\text{FeO}}^{\text{Mag}} + v_{\text{FeO}}^{1-2} = 0$$

$$J_{\text{MgO}}^{\text{Alm}} + J_{\text{MgO}}^{\text{Olg}} + J_{\text{MgO}}^{\text{Mag}} + v_{\text{MgO}}^{1-2} = 0$$

$$J_{\text{CaO}}^{\text{Alm}} + J_{\text{CaO}}^{\text{Olg}} + J_{\text{CaO}}^{\text{Mag}} + v_{\text{CaO}}^{1-2} = 0$$

$$J_{\text{SiO}_2}^{\text{Olg}} + J_{\text{SiO}_2}^{\text{Mag}} + J_{\text{SiO}_2}^{\text{Hyp}} + J_{\text{SiO}_2}^{\text{Aug}} + v_{\text{SiO}_2}^{2-3} = 0$$

$$J_{\text{AlO}_{3/2}}^{\text{Olg}} + J_{\text{AlO}_{3/2}}^{\text{Mag}} + J_{\text{AlO}_{3/2}}^{\text{Hyp}} + J_{\text{AlO}_{3/2}}^{\text{Aug}} + v_{\text{AlO}_{3/2}}^{2-3} = 0$$

$$J_{\text{FeO}}^{\text{Olg}} + J_{\text{FeO}}^{\text{Mag}} + J_{\text{FeO}}^{\text{Hyp}} + J_{\text{FeO}}^{\text{Aug}} + v_{\text{FeO}}^{2-3} = 0$$

$$J_{\text{MgO}}^{\text{Olg}} + J_{\text{MgO}}^{\text{Mag}} + J_{\text{MgO}}^{\text{Hyp}} + J_{\text{MgO}}^{\text{Aug}} + v_{\text{MgO}}^{2-3} = 0$$

$$J_{\text{CaO}}^{\text{Olg}} + J_{\text{CaO}}^{\text{Mag}} + J_{\text{CaO}}^{\text{Hyp}} + J_{\text{CaO}}^{\text{Aug}} + v_{\text{CaO}}^{2-3} = 0$$

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$$J_{\text{SiO}_2}^{\text{Hyp}} + J_{\text{SiO}_2}^{\text{Aug}} + J_{\text{SiO}_2}^{\text{Qtz}} + v_{\text{SiO}_2}^{3-4} = 0$$

$$J_{\text{AlO}_{3/2}}^{\text{Hyp}} + J_{\text{AlO}_{3/2}}^{\text{Aug}} + J_{\text{AlO}_{3/2}}^{\text{Qtz}} + v_{\text{AlO}_{3/2}}^{3-4} = 0$$

$$J_{\text{FeO}}^{\text{Hyp}} + J_{\text{FeO}}^{\text{Aug}} + J_{\text{FeO}}^{\text{Qtz}} + v_{\text{FeO}}^{3-4} = 0$$

$$J_{\text{MgO}}^{\text{Hyp}} + J_{\text{MgO}}^{\text{Aug}} + J_{\text{MgO}}^{\text{Qtz}} + v_{\text{MgO}}^{3-4} = 0$$

$$J_{\text{CaO}}^{\text{Hyp}} + J_{\text{CaO}}^{\text{Aug}} + J_{\text{CaO}}^{\text{Qtz}} + v_{\text{CaO}}^{3-4} = 0$$

## Flux-Ratio Equations

$$2.75 J_{\text{SiO}_2}^{\text{Olg}} + 1.25 J_{\text{AlO}_{3/2}}^{\text{Olg}} \left( \frac{L_{\text{Si}}}{L_{\text{Al}}} \right) + 0.00 J_{\text{FeO}}^{\text{Olg}} \left( \frac{L_{\text{Si}}}{L_{\text{Fe}}} \right) + 0.00 J_{\text{MgO}}^{\text{Olg}} \left( \frac{L_{\text{Si}}}{L_{\text{Mg}}} \right) + 0.25 J_{\text{CaO}}^{\text{Olg}} \left( \frac{L_{\text{Si}}}{L_{\text{Ca}}} \right) = 0$$

$$0.00 J_{\text{SiO}_2}^{\text{Mag}} + 0.00 J_{\text{AlO}_{3/2}}^{\text{Mag}} \left( \frac{L_{\text{Si}}}{L_{\text{Al}}} \right) + 3.00 J_{\text{FeO}}^{\text{Mag}} \left( \frac{L_{\text{Si}}}{L_{\text{Fe}}} \right) + 0.00 J_{\text{MgO}}^{\text{Mag}} \left( \frac{L_{\text{Si}}}{L_{\text{Mg}}} \right) + 0.00 J_{\text{CaO}}^{\text{Mag}} \left( \frac{L_{\text{Si}}}{L_{\text{Ca}}} \right) = 0$$

$$1.99 J_{\text{SiO}_2}^{\text{Hyp}} + 0.01 J_{\text{AlO}_{3/2}}^{\text{Hyp}} \left( \frac{L_{\text{Si}}}{L_{\text{Al}}} \right) + 0.99 J_{\text{FeO}}^{\text{Hyp}} \left( \frac{L_{\text{Si}}}{L_{\text{Fe}}} \right) + 0.92 J_{\text{MgO}}^{\text{Hyp}} \left( \frac{L_{\text{Si}}}{L_{\text{Mg}}} \right) + 0.03 J_{\text{CaO}}^{\text{Hyp}} \left( \frac{L_{\text{Si}}}{L_{\text{Ca}}} \right) = 0$$

$$2.00 J_{\text{SiO}_2}^{\text{Aug}} + 0.03 J_{\text{AlO}_{3/2}}^{\text{Aug}} \left( \frac{L_{\text{Si}}}{L_{\text{Al}}} \right) + 0.36 J_{\text{FeO}}^{\text{Aug}} \left( \frac{L_{\text{Si}}}{L_{\text{Fe}}} \right) + 0.70 J_{\text{MgO}}^{\text{Aug}} \left( \frac{L_{\text{Si}}}{L_{\text{Mg}}} \right) + 0.85 J_{\text{CaO}}^{\text{Aug}} \left( \frac{L_{\text{Si}}}{L_{\text{Ca}}} \right) = 0$$

## Boundary-Flux Equations

$$J_{\text{SiO}_2}^{\text{Alm}} = 0 \qquad J_{\text{SiO}_2}^{\text{Qtz}} = 0.82$$

$$J_{\text{Al}_2\text{O}_3}^{\text{Alm}} = 0 \qquad J_{\text{Al}_2\text{O}_3}^{\text{Qtz}} = 0.58$$

$$J_{\text{FeO}}^{\text{Alm}} = 0 \qquad J_{\text{FeO}}^{\text{Qtz}} = 0.43$$

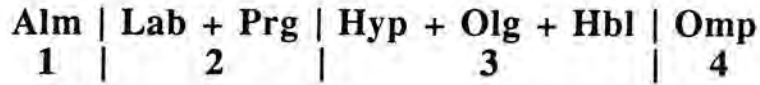
$$J_{\text{MgO}}^{\text{Alm}} = 0 \qquad J_{\text{MgO}}^{\text{Qtz}} = -0.21$$

$$J_{\text{CaO}}^{\text{Alm}} = 0 \qquad J_{\text{CaO}}^{\text{Qtz}} = 0.07$$

## Extent-of-Reaction Equation

$$v_{\text{Alm}}^{1-2} = 1$$

**EQUATIONS USED IN STEADY-DIFFUSION MODEL OF  
GARNET-OMPHACITE CORONA**



**Material-Balance Equations**

$$v_{\text{SiO}_2}^{1-2} + 3.00 v_{\text{Alm}}^{1-2} + 2.40 v_{\text{Lab}}^{1-2} + 6.08 v_{\text{Prg}}^{1-2} = 0$$

$$v_{\text{AlO}_{3/2}}^{1-2} + 1.98 v_{\text{Alm}}^{1-2} + 1.60 v_{\text{Lab}}^{1-2} + 2.50 v_{\text{Prg}}^{1-2} = 0$$

$$v_{\text{FeO}}^{1-2} + 1.66 v_{\text{Alm}}^{1-2} + 0.00 v_{\text{Lab}}^{1-2} + 1.66 v_{\text{Prg}}^{1-2} = 0$$

$$v_{\text{MgO}}^{1-2} + 0.78 v_{\text{Alm}}^{1-2} + 0.00 v_{\text{Lab}}^{1-2} + 2.64 v_{\text{Prg}}^{1-2} = 0$$

$$v_{\text{CaO}}^{1-2} + 0.58 v_{\text{Alm}}^{1-2} + 0.60 v_{\text{Lab}}^{1-2} + 1.79 v_{\text{Prg}}^{1-2} = 0$$

$$v_{\text{NaO}_{1/2}}^{1-2} + 0.00 v_{\text{Alm}}^{1-2} + 0.40 v_{\text{Lab}}^{1-2} + 0.83 v_{\text{Prg}}^{1-2} = 0$$

$$v_{\text{SiO}_2}^{2-3} + 2.40 v_{\text{Lab}}^{2-3} + 6.08 v_{\text{Prg}}^{2-3} + 1.99 v_{\text{Hyp}}^{2-3} + 2.77 v_{\text{Olg}}^{2-3} + 6.69 v_{\text{Hbl}}^{2-3} = 0$$

$$v_{\text{AlO}_{3/2}}^{2-3} + 1.60 v_{\text{Lab}}^{2-3} + 2.50 v_{\text{Prg}}^{2-3} + 0.02 v_{\text{Hyp}}^{2-3} + 1.23 v_{\text{Olg}}^{2-3} + 1.59 v_{\text{Hbl}}^{2-3} = 0$$

$$v_{\text{FeO}}^{2-3} + 0.00 v_{\text{Lab}}^{2-3} + 1.66 v_{\text{Prg}}^{2-3} + 0.78 v_{\text{Hyp}}^{2-3} + 0.00 v_{\text{Olg}}^{2-3} + 1.48 v_{\text{Hbl}}^{2-3} = 0$$

$$v_{\text{MgO}}^{2-3} + 0.00 v_{\text{Lab}}^{2-3} + 2.64 v_{\text{Prg}}^{2-3} + 1.19 v_{\text{Hyp}}^{2-3} + 0.00 v_{\text{Olg}}^{2-3} + 3.02 v_{\text{Hbl}}^{2-3} = 0$$

$$v_{\text{CaO}}^{2-3} + 0.60 v_{\text{Lab}}^{2-3} + 1.79 v_{\text{Prg}}^{2-3} + 0.02 v_{\text{Hyp}}^{2-3} + 0.23 v_{\text{Olg}}^{2-3} + 1.81 v_{\text{Hbl}}^{2-3} = 0$$

$$v_{\text{NaO}_{1/2}}^{2-3} + 0.40 v_{\text{Lab}}^{2-3} + 0.83 v_{\text{Prg}}^{2-3} + 0.00 v_{\text{Hyp}}^{2-3} + 0.77 v_{\text{Olg}}^{2-3} + 0.63 v_{\text{Hbl}}^{2-3} = 0$$

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$$v_{\text{SiO}_2}^{3-4} + 1.99 v_{\text{Hyp}}^{3-4} + 2.77 v_{\text{Olg}}^{3-4} + 6.69 v_{\text{Hbl}}^{3-4} + 2.00 v_{\text{Omp}}^{3-4} = 0$$

$$v_{\text{AlO}_{3/2}}^{3-4} + 0.02 v_{\text{Hyp}}^{3-4} + 1.23 v_{\text{Olg}}^{3-4} + 1.59 v_{\text{Hbl}}^{3-4} + 0.35 v_{\text{Omp}}^{3-4} = 0$$

$$v_{\text{FeO}}^{3-4} + 0.78 v_{\text{Hyp}}^{3-4} + 0.00 v_{\text{Olg}}^{3-4} + 1.48 v_{\text{Hbl}}^{3-4} + 0.17 v_{\text{Omp}}^{3-4} = 0$$

$$v_{\text{MgO}}^{3-4} + 1.19 v_{\text{Hyp}}^{3-4} + 0.00 v_{\text{Olg}}^{3-4} + 3.02 v_{\text{Hbl}}^{3-4} + 0.51 v_{\text{Omp}}^{3-4} = 0$$

$$v_{\text{CaO}}^{3-4} + 0.02 v_{\text{Hyp}}^{3-4} + 0.23 v_{\text{Olg}}^{3-4} + 1.81 v_{\text{Hbl}}^{3-4} + 0.58 v_{\text{Omp}}^{3-4} = 0$$

$$v_{\text{NaO}_{1/2}}^{3-4} + 0.00 v_{\text{Hyp}}^{3-4} + 0.77 v_{\text{Olg}}^{3-4} + 0.63 v_{\text{Hbl}}^{3-4} + 0.38 v_{\text{Omp}}^{3-4} = 0$$

## Steady-Diffusion (Conservation) Equations

$$J_{\text{SiO}_2}^{\text{Alm}} + J_{\text{SiO}_2}^{\text{Lab}} + J_{\text{SiO}_2}^{\text{Prg}} + v_{\text{SiO}_2}^{1-2} = 0$$

$$J_{\text{AlO}_{3/2}}^{\text{Alm}} + J_{\text{AlO}_{3/2}}^{\text{Lab}} + J_{\text{AlO}_{3/2}}^{\text{Prg}} + v_{\text{AlO}_{3/2}}^{1-2} = 0$$

$$J_{\text{FeO}}^{\text{Alm}} + J_{\text{FeO}}^{\text{Lab}} + J_{\text{FeO}}^{\text{Prg}} + v_{\text{FeO}}^{1-2} = 0$$

$$J_{\text{MgO}}^{\text{Alm}} + J_{\text{MgO}}^{\text{Lab}} + J_{\text{MgO}}^{\text{Prg}} + v_{\text{MgO}}^{1-2} = 0$$

$$J_{\text{CaO}}^{\text{Alm}} + J_{\text{CaO}}^{\text{Lab}} + J_{\text{CaO}}^{\text{Prg}} + v_{\text{CaO}}^{1-2} = 0$$

$$J_{\text{NaO}_{1/2}}^{\text{Alm}} + J_{\text{NaO}_{1/2}}^{\text{Lab}} + J_{\text{NaO}_{1/2}}^{\text{Prg}} + v_{\text{NaO}_{1/2}}^{1-2} = 0$$



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$$J_{\text{SiO}_2}^{\text{Lab}} + J_{\text{SiO}_2}^{\text{Prg}} + J_{\text{SiO}_2}^{\text{Hyp}} + J_{\text{SiO}_2}^{\text{Olg}} + J_{\text{SiO}_2}^{\text{Hbl}} + v_{\text{SiO}_2}^{2-3} = 0$$

$$J_{\text{AlO}_{3/2}}^{\text{Lab}} + J_{\text{AlO}_{3/2}}^{\text{Prg}} + J_{\text{AlO}_{3/2}}^{\text{Hyp}} + J_{\text{AlO}_{3/2}}^{\text{Olg}} + J_{\text{AlO}_{3/2}}^{\text{Hbl}} + v_{\text{AlO}_{3/2}}^{2-3} = 0$$

$$J_{\text{FeO}}^{\text{Lab}} + J_{\text{FeO}}^{\text{Prg}} + J_{\text{FeO}}^{\text{Hyp}} + J_{\text{FeO}}^{\text{Olg}} + J_{\text{FeO}}^{\text{Hbl}} + J_{\text{FeO}}^{2-3} = 0$$

$$J_{\text{MgO}}^{\text{Lab}} + J_{\text{MgO}}^{\text{Prg}} + J_{\text{MgO}}^{\text{Hyp}} + J_{\text{MgO}}^{\text{Olg}} + J_{\text{MgO}}^{\text{Hbl}} + v_{\text{MgO}}^{2-3} = 0$$

$$J_{\text{CaO}}^{\text{Lab}} + J_{\text{CaO}}^{\text{Prg}} + J_{\text{CaO}}^{\text{Hyp}} + J_{\text{CaO}}^{\text{Olg}} + J_{\text{CaO}}^{\text{Hbl}} + v_{\text{CaO}}^{2-3} = 0$$

$$J_{\text{NaO}_{1/2}}^{\text{Lab}} + J_{\text{NaO}_{1/2}}^{\text{Prg}} + J_{\text{NaO}_{1/2}}^{\text{Hyp}} + J_{\text{NaO}_{1/2}}^{\text{Olg}} + J_{\text{NaO}_{1/2}}^{\text{Hbl}} + v_{\text{NaO}_{1/2}}^{2-3} = 0$$

$$J_{\text{SiO}_2}^{\text{Hyp}} + J_{\text{SiO}_2}^{\text{Olg}} + J_{\text{SiO}_2}^{\text{Hbl}} + J_{\text{SiO}_2}^{\text{Omp}} + v_{\text{SiO}_2}^{3-4} = 0$$

$$J_{\text{AlO}_{3/2}}^{\text{Hyp}} + J_{\text{AlO}_{3/2}}^{\text{Olg}} + J_{\text{AlO}_{3/2}}^{\text{Hbl}} + J_{\text{AlO}_{3/2}}^{\text{Omp}} + v_{\text{AlO}_{3/2}}^{3-4} = 0$$

$$J_{\text{FeO}}^{\text{Hyp}} + J_{\text{FeO}}^{\text{Olg}} + J_{\text{FeO}}^{\text{Hbl}} + J_{\text{FeO}}^{\text{Omp}} + v_{\text{FeO}}^{3-4} = 0$$

$$J_{\text{MgO}}^{\text{Hyp}} + J_{\text{MgO}}^{\text{Olg}} + J_{\text{MgO}}^{\text{Hbl}} + J_{\text{MgO}}^{\text{Omp}} + v_{\text{MgO}}^{3-4} = 0$$

$$J_{\text{CaO}}^{\text{Hyp}} + J_{\text{CaO}}^{\text{Olg}} + J_{\text{CaO}}^{\text{Hbl}} + J_{\text{CaO}}^{\text{Omp}} + v_{\text{CaO}}^{3-4} = 0$$

$$J_{\text{NaO}_{1/2}}^{\text{Hyp}} + J_{\text{NaO}_{1/2}}^{\text{Olg}} + J_{\text{NaO}_{1/2}}^{\text{Hbl}} + J_{\text{NaO}_{1/2}}^{\text{Omp}} + v_{\text{NaO}_{1/2}}^{3-4} = 0$$

## Flux-Ratio Equations

$$2.40 J_{\text{SiO}_2}^{\text{Lab}} + 1.60 J_{\text{AlO}_{3/2}}^{\text{Lab}} \left( \frac{L_{\text{Si}}}{L_{\text{Al}}} \right) + 0.00 J_{\text{FeO}}^{\text{Lab}} \left( \frac{L_{\text{Si}}}{L_{\text{Fe}}} \right) + 0.00 J_{\text{MgO}}^{\text{Lab}} \left( \frac{L_{\text{Si}}}{L_{\text{Mg}}} \right) \\ + 0.60 J_{\text{CaO}}^{\text{Lab}} \left( \frac{L_{\text{Si}}}{L_{\text{Ca}}} \right) + 0.40 J_{\text{NaO}_{1/2}}^{\text{Lab}} \left( \frac{L_{\text{Si}}}{L_{\text{Na}}} \right) = 0$$

$$6.08 J_{\text{SiO}_2}^{\text{Prg}} + 2.50 J_{\text{AlO}_{3/2}}^{\text{Prg}} \left( \frac{L_{\text{Si}}}{L_{\text{Al}}} \right) + 1.66 J_{\text{FeO}}^{\text{Prg}} \left( \frac{L_{\text{Si}}}{L_{\text{Fe}}} \right) + 2.64 J_{\text{MgO}}^{\text{Prg}} \left( \frac{L_{\text{Si}}}{L_{\text{Mg}}} \right) \\ + 1.79 J_{\text{CaO}}^{\text{Prg}} \left( \frac{L_{\text{Si}}}{L_{\text{Ca}}} \right) + 0.83 J_{\text{NaO}_{1/2}}^{\text{Prg}} \left( \frac{L_{\text{Si}}}{L_{\text{Na}}} \right) = 0$$

$$1.99 J_{\text{SiO}_2}^{\text{Hyp}} + 0.02 J_{\text{AlO}_{3/2}}^{\text{Hyp}} \left( \frac{L_{\text{Si}}}{L_{\text{Al}}} \right) + 0.78 J_{\text{FeO}}^{\text{Hyp}} \left( \frac{L_{\text{Si}}}{L_{\text{Fe}}} \right) + 1.19 J_{\text{MgO}}^{\text{Hyp}} \left( \frac{L_{\text{Si}}}{L_{\text{Mg}}} \right) \\ + 0.02 J_{\text{CaO}}^{\text{Hyp}} \left( \frac{L_{\text{Si}}}{L_{\text{Ca}}} \right) + 0.00 J_{\text{NaO}_{1/2}}^{\text{Hyp}} \left( \frac{L_{\text{Si}}}{L_{\text{Na}}} \right) = 0$$

$$2.77 J_{\text{SiO}_2}^{\text{Olg}} + 1.23 J_{\text{AlO}_{3/2}}^{\text{Olg}} \left( \frac{L_{\text{Si}}}{L_{\text{Al}}} \right) + 0.00 J_{\text{FeO}}^{\text{Olg}} \left( \frac{L_{\text{Si}}}{L_{\text{Fe}}} \right) + 0.00 J_{\text{MgO}}^{\text{Olg}} \left( \frac{L_{\text{Si}}}{L_{\text{Mg}}} \right) \\ + 0.23 J_{\text{CaO}}^{\text{Olg}} \left( \frac{L_{\text{Si}}}{L_{\text{Ca}}} \right) + 0.77 J_{\text{NaO}_{1/2}}^{\text{Olg}} \left( \frac{L_{\text{Si}}}{L_{\text{Na}}} \right) = 0$$

$$6.69 J_{\text{SiO}_2}^{\text{Hbl}} + 1.59 J_{\text{AlO}_{3/2}}^{\text{Hbl}} \left( \frac{L_{\text{Si}}}{L_{\text{Al}}} \right) + 1.48 J_{\text{FeO}}^{\text{Hbl}} \left( \frac{L_{\text{Si}}}{L_{\text{Fe}}} \right) + 3.02 J_{\text{MgO}}^{\text{Hbl}} \left( \frac{L_{\text{Si}}}{L_{\text{Mg}}} \right) \\ + 1.81 J_{\text{CaO}}^{\text{Hbl}} \left( \frac{L_{\text{Si}}}{L_{\text{Ca}}} \right) + 0.63 J_{\text{NaO}_{1/2}}^{\text{Hbl}} \left( \frac{L_{\text{Si}}}{L_{\text{Na}}} \right) = 0$$

## Boundary-Flux Equations

$$J_{\text{SiO}_2}^{\text{Alm}} = 0 \quad J_{\text{SiO}_2}^{\text{Omp}} = 0.57$$

$$J_{\text{Al}_2\text{O}_3}^{\text{Alm}} = 0 \quad J_{\text{Al}_2\text{O}_3}^{\text{Omp}} = -0.29$$

$$J_{\text{FeO}}^{\text{Alm}} = 0 \quad J_{\text{FeO}}^{\text{Omp}} = 1.53$$

$$J_{\text{MgO}}^{\text{Alm}} = 0 \quad J_{\text{MgO}}^{\text{Omp}} = 1.02$$

$$J_{\text{CaO}}^{\text{Alm}} = 0 \quad J_{\text{CaO}}^{\text{Omp}} = 0.69$$

$$J_{\text{Na}_2\text{O}}^{\text{Alm}} = 0 \quad J_{\text{Na}_2\text{O}}^{\text{Omp}} = -0.40$$

## Extent- of-Reaction Equation

$$v_{\text{Alm}}^{1-2} = 1$$