to compare exchange of ion I and Ca in $CaMgSi_2O_6$

$$\Delta G_I = \Delta G_{Ca} + \Delta G^{melt\to 0}_{strain} - \Delta G^{cpx}_{strain}$$

What about the strain in the melt?
- Assume much smaller than crystal

$$\Delta G^{cpx}_{strain} = \Delta G_{Ca} - \Delta G_I$$

$$\Delta G^{cpx}_{strain} = -RT \ln D_{Ca} + RT \ln D_I \qquad \ln X - \ln Y = \ln \frac{X}{Y}$$

$$\Delta G^{cpx}_{strain} = -RT \left(\ln \frac{D_I}{D_{Ca}} \right)$$

$$-\frac{\Delta G^{cpx}_{strain}}{RT} = \ln \frac{D_I}{D_{Ca}}$$

$$e^{\left(-\frac{\Delta G^{cpx}_{strain}}{RT}\right)} = \frac{D_I}{D_{Ca}}$$

$$D_{Ca}\, e^{\left(-\frac{\Delta G^{cpx}_{strain}}{RT}\right)} = D_I$$

ionic radius change

$$W = E 4\pi \left(\frac{1}{3}(r_1 - r_0)^3 - \frac{r_0}{2}(r_1 - r_0)^2 \right) = \Delta G^{cpx}_{strain}$$

What about charge?

$$E \sim \frac{3K}{1-2\sigma}$$

K — Bulk modulus

σ — poisson's ratio