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Calculations of fluid–ternary solid solution equilibria: An application of the Wilson equation to fluid–(Fe,Mn,Mg)TiO_3 equilibria at 600 °C and 1 kbar

Y. SHIBUE

Geoscience Institute, Hyogo University of Teacher Education, Hyogo 673-1494, Japan

ABSTRACT

The Wilson equation (Wilson 1964) is applied to (Fe,Mn,Mg)TiO_3 solid solutions for obtaining the mixing properties of the ternary solid solution at 600 °C and 1 kbar. The present study utilizes data on cation exchange between (Fe,Mn)$Cl_{2(aq)}$ and (Fe,Mn)TiO_3, between (Mn,Mg)$Cl_{2(aq)}$ and (Mn,Mg)TiO_3, and between (Fe,Mg)$Cl_{2(aq)}$ and (Fe,Mg)TiO_3 (Kubo et al. 1992). The molar excess Gibbs energy (G^{ex}) is the following: G^{ex} (kJ/mol) = $-7.260[X_{FeTiO_3}\ln(X_{FeTiO_3} + 1.314X_{MnTiO_3} + 0.962X_{MgTiO_3}) + X_{MnTiO_3}\ln(0.585X_{FeTiO_3} + X_{MnTiO_3} + 0.393X_{MgTiO_3}) + X_{MgTiO_3}\ln(0.406X_{FeTiO_3} + 0.371X_{MnTiO_3} + X_{MgTiO_3})]$, where X stands for the mole fraction of the subscripted component. The predicted compositions of (Fe,Mn,Mg)$Cl_{2(aq)}$ fluids in equilibrium with the ternary solid solutions are in good agreement with the experimental values.