

The effect of phosphorus on manganocolumbite and manganotantalite solubility in peralkaline to peraluminous granitic melts

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ABSTRACT

Solubility experiments of Mn-columbite (MnNb_2O_6) and Mn-tantalite (MnTa_2O_6) were conducted under water-saturated conditions in synthetic haplogranitic melts containing different amounts of phosphorus at 800 °C and 100 MPa. All experiments were carried out in cold-seal rapid quenching pressure vessels (RQV) with water as a pressure medium. Experimental results show that: (1) the solubilities of MnNb_2O_6 and MnTa_2O_6 in peralkaline melts are higher than those in peraluminous melts; (2) phosphorus has strong influence on the solubilities of MnTa_2O_6 and MnNb_2O_6 in peralkaline melts, $K_{\text{Sp}}^{\text{Nb}}$ and $K_{\text{Sp}}^{\text{Ta}}$ decrease from $104.89 \times 10^{-4} \text{ mol}^2/\text{kg}^2$ and $107.62 \times 10^{-4} \text{ mol}^2/\text{kg}^2$ for melts without P_2O_5 to $16.11 \times 10^{-4} \text{ mol}^2/\text{kg}^2$ and $7.96 \times 10^{-4} \text{ mol}^2/\text{kg}^2$ for melts containing ~4.00 wt% P_2O_5 , respectively; (3) phosphorus has less influence on the solubilities of MnTa_2O_6 and MnNb_2O_6 in peraluminous melt, $K_{\text{Sp}}^{\text{Nb}}$ decrease from $4.50 \times 10^{-4} \text{ mol}^2/\text{kg}^2$ for melts without P_2O_5 to $0.73 \times 10^{-4} \text{ mol}^2/\text{kg}^2$, and $K_{\text{Sp}}^{\text{Ta}}$ from $3.57 \times 10^{-4} \text{ mol}^2/\text{kg}^2$ to $0.14 \times 10^{-4} \text{ mol}^2/\text{kg}^2$ for melts containing ~5.00 wt% P_2O_5 . Taking the structural role of phosphorus into account, P decreases the solubility of Mn-columbite and Mn-tantalite via competing for network modifiers.

Keywords: Columbite, tantalite, solubility, phosphorus, melt