

The effect of H₂O on olivine crystallization in MORB: Experimental calibration at 200 MPa

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ABSTRACT

Crystallization experiments were conducted at 200 MPa and water-undersaturated conditions to quantify the effect of small amounts of H₂O on the crystallization temperature of olivine in basaltic melts (e.g., Mid-Oceanic Ridge Basalts, MORB). The H₂O concentrations in the quenched glasses, determined by infrared spectroscopy and Karl-Fischer-Titration, ranged between 0.25 and 4.2 wt% H₂O. The dry liquidus temperature was estimated from experiments at 0.1 MPa (H₂O-free) and from the known pressure dependence of olivine crystallization temperature. The liquidus temperature depression can be predicted by the empirical equation ($T^{\text{DRY}} - T^{\text{WET}} = 39.69 \cdot C_{\text{H}_2\text{O}}^{0.73} (\text{wt}\%)$). The comparison of the experimental results with available crystallization models and empirical methods shows that most of the predicted liquidus temperature depressions differ significantly from that observed in this study.

Keywords: Crystallization, H₂O, MORB, olivine, liquidus, FTIR, KFT