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Experimental investigation of crystallization kinetics in a haplogranite system

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ABSTRACT

A haplogranite composition (73 wt% SiO_2) has been studied experimentally to investigate the kinetics of crystallization. A series of equilibrium experiments over a range of pressures (5–200 MPa) and temperatures (825–1185 °C) determined the stable phases at water-saturated conditions. The haplogranite system crystallizes plagioclase over a broad range of pressures and temperatures, with crystalline silica and then alkali feldspar becoming stable at progressively lower temperatures and pressures. Plagioclase An contents decrease and bulk crystal fractions increase as experimental conditions tend to lower pressures and temperatures. A second series of experiments investigated the kinetics of crystallization induced by depressurization and associated water exsolution. A nucleation delay of at least 4 hours is estimated for all final pressures (P_f) studied. The amount of crystallization increases as P_f decreases and experimental duration and undercooling increase. Nucleation and growth rates are observed to increase with undercooling, although at very high undercoolings, growth rates start to decrease. Comparison with other experimental studies shows the importance of composition and water content to nucleation and growth rates. Increasing water content lowers melt viscosity, aiding crystallization.