Ising models of undercooled binary system crystallization:
Comparison with experimental and pegmatite textures

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ABSTRACT

Simulations of crystal growth in hydrous albite-quartz and albite-orthoclase systems were performed with the Jackson, Gilmer, and Temkin formulation of the Ising model. These simulations demonstrate that at 873 K (approximately 100 K undercooling), comb textures are produced when growth and diffusion probabilities are equivalent. If the growth probability is decreased to 0.1 times that of diffusion, discrete alternating zones of albite and quartz are produced; however, increasing the growth probability to 10 times that of diffusion results in an intergrowth of small domains of albite set in a quartz matrix. At near-liquidus temperatures (973 K), textures similar to those at 100 K undercooling are produced although the crystal-melt interfaces of the comb texture are smoother and the absolute value of the diffusion probability exerts a strong control on the texture, unlike results at 873 K. The textures produced in the simulations with a scale of 10^{-7} m are similar to experimentally produced textures with scales of 10^{-6} to 10^{-4}. The fractal dimension of a comb-textured simulation has been measured and shown to be similar to the fractal dimension of a natural pegmatite with a meter-scale texture. This scaling similarity suggests that these simulations may provide insight into the formation of natural pegmatites despite the 5–7 orders of magnitude difference in scale.