Numerical model of oscillatory nucleation of crystal in cooling magma body, II: Eutectic oscillation

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The cyclic layering (or vesicle layering) is commonly observed in sills and dikes. The cyclic layering is thought to form due to the interplay between the thermal and mass diffusions and the nonlinear reaction (crystallization or vesiculation) with non-zero degree of supersaturation. In the previous talk, I reported the result of numerical solutions of the governing equations which describe the diffusions of mass and heat with crystallization kinetics of the liquidus phase (the 1st crystallizing phase) for a binary eutectic melt in the one-dimensional conductive cooling. The numerical solutions show the oscillatory nucleation of crystals of the liquidus phase for unrealistically high value of D/K (inverse of Lewis number): where D is mass diffusivity, K thermal diffusivity) and the layering structure in which the volume fraction, number density of crystals and mean crystal radius of the 1st crystallizing phase vary periodically in space according to the spacing law of the geometrical progression with a ratio constant as a function of Lewis number is obtained. For realistic values of D/K, however, we could not obtain the oscillatory solutions. In the present talk, I report the result of numerical study for the second crystallizing phase. As a result of the numerical study, it is found that the oscillatory crystallization of the second crystallizing phase at the eutectic point can occur even for realistic range of the parameter value (referred to as eutectic oscillation). This result suggests that the cyclic layering in dikes and sills can be explained by the eutectic oscillation.