Spinodal decomposition in a three component systems: microstructure evolution during exsolution of ternary feldspar

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Phase separation in a ternary system is considered. The separation occurs by virtue of the spinodal decomposition mechanism and corresponds to a nonlinear uphill diffusion. The latter is described in terms of the generalized chemical potential that explicitly depends on component concentrations and therefore implicitly depends on space coordinates and time. In accord with general thermodynamic laws the chemical potential of each component becomes a uniform constant throughout the system as it evolves to an equilibrium state.
The region of unstable concentrations is found numerically on the ternary diagram together with the final compositions of the exsolved phases. Decomposition dynamics is described by corresponding multi-component generalization of the original equation of Cahn and
Hilliard. A possible intrinsic anisotropy of the system is taken into account by considering anisotropic terms accounting for the surface energy contribution. Such anisotropy may be responsible for the formation of elongated lamellae. Multicomponent Cahn-Hilliard equations are solved numerically using finite elements routine.
The model is applied to perthite formation in ternary feldspar. Realistic regions of temperatures and pressures are considered having in mind specific geologic applications. Various cooling scenarios are investigated to address the influence of cooling rate on the size and the compositions of the exsolved phases.

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