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The influence of rock matrix in the development of porphyroblasts during metamorphism

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Rocks respond to changing pressure and/or temperature by modifying their mineralogies and microtextures in a definable interplay between several physical and chemical processes. Here we model differences in the growth of specific textures and mineral compositions as a result of varying initial chemical (mineralogical) configurations and diffusional constraints. Thus we consider rocks to be composed of one or several kinds of porphyroblast phase surrounded by a matrix $\pm$ a fluid phase on grain boundaries. Attainment of equilibrium is aided by efficient intergranular and intragranular diffusion, which in turn depends on temperature, rate of heating/cooling, grain size, and faster intragranular diffusion. This in turn suggests a transient presence of a fluid phase.
1-dimensional calculations suggest appropriate diffusion coefficients for the range of crystal sizes grown during typical metamorphic events. Simple 2-dimensional models highlight to what extent rock matrix texture (grain-size, mineral assemblage, mineral distribution, fluid availability) influences the development of porphyroblasts and subsequent textures formed. Key to this is identification of the most appropriate species to consider as experiencing diffusive flux during the model, and those which can be considered as effectively inert. Here we consider combinations of Al, Si, Fe, Mg, Ca and H2O, omitting K, Na and other components from these initial calculations. By varying initial textural parameters, we study the development of specific kinds of porphyroblast (e.g. garnet in metapelite), recording their composition, compositional zoning, size, shape and distribution.