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Textural and numerical study of cordierite growth in the Adamello contact aureole, Italy

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The study of metamorphic textures in contact aureoles provides excellent insights in the kinetics and mechanism of metamorphic processes. In general, the growth of a mineral involves the following fundamental mechanism: Development of a chemical potential gradient by initiation of a reaction triggered by heating a system, dissolution of reactant minerals, transport of nutrients, nucleation of product minerals and precipitation of the product mineral on the surface of the nucleus. The overall reaction rate is always limited by the slowest of these mechanisms (Fisher, 1978). Since all processes occur simultaneously (on rock scale) and can interact with each other, the rate-limiting step might change over the period of growth and therefore results in the formation of various textures (Carlson, 2010).
In this study, we investigate different cordierite growth textures formed by low P/high T contact metamorphism due to the emplacement of the Adamello batholith, a Tertiary intrusion of mostly granodioritic to tonalitic composition (Callegari & Dal Piaz, 1973). The cordierites show variable morphologies from egg-shaped, almost spherical porphyroblasts to irregular, dendrite- or tree-like patterns. Both textures tend to form poikiloblasts with inclusions dominated by quartz. Preliminary results suggest that one discriminating factor is the variation of bulk rock chemistry, since different morphologies were observed within a single outcrop, which experienced a unique temperature-time path. Rocks displaying dendritic growth are generally higher in bulk rock SiO_2 than samples with roundish cordierite porphyroblast. Additionally, all different morphologies can occur with halos, indicating diffusion limited growth, and without halos. The halos, of variable sizes and shapes, are biotite-free, but contain otherwise the same mineralogy as the matrix (muscovite – K-feldspar – quartz – oxide – plagioclase). To test these findings we will conduct a numerical experiment using a 2D finite difference scheme.

References

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