Crystal nucleation and growth in heterogeneous matrices: A case study from the Castner Marble, Texas

E.L. BACKUS[1] AND C.J. HETHERINGTON[1]

[1]Texas Tech University, Box 41053, Lubbock, TX 79409-1053, USA *(ethan.backus@ttu.edu)

Porphyroblast growth is considered to occur by either interface or diffusion controlled nucleation and growth [1]. A commonly overlooked feature of metamorphic rocks are polycrystals that may impact textural interpretation of compositional zoning and provide information about crystal growth processes [2]. Polycrystals or agglomerates suggest a lack of compositional gradients during porphyroblast growth, possibly due to the presence of a fluid.

The Castner Marble is a layered calc-silicate in which garnets grew during a single contact metamorphic event and occur in four morphologies: 1) elongate at the hornfels-marble boundary; 2) subidioblastic-idioblastic oscillatory zoned garnet growing from the marble-hornfels boundary into the marble; 3) subidioblastic equant grains within marble layers; and 4) elongate in marble layers with oscillatory zoning parallel to compositional layering. All garnets are grossular with a lesser andradite component and display osciallatory, patchy, or massive compositional zoning. An inverse correlation exists between Fe^{3+}, La, Ce, & Nd, and Al & Ti, suggesting substitution occurs in the octahedral site. Meanwhile a diffusion concentration gradient with increasing REE content towards garnet is observed in adjacent recrystallized calcite.

Three types of grain-crystallographies were identified by EBSD. 1) Polycrystals with multiple sub-grains, 2) crystal agglomerates made of discrete grains, and 3) elongate single crystals. Agglomerates and polycrystals suggest interface controlled nucleation and growth, whereas either mechanism could have contributed to the growth of the single crystals.

Along layer boundaries and within marble layers advections controlled transport of elements for polycrystal or agglomerate growth, while diffusion simultaneously controlled the transport of some trace elements. Moreover, after nucleation of one garnet, nucleation potential of subsequent garnets in the general rock volume is suppressed. Advection induced super-saturation at existing garnet crystal faces promoted higher nucleation affinity and growth of agglomeratic and polycrystal textures

[1] Carlson (2011) *Intl. Geol. Rev.* **53**, 406-445. [2] Whitney and Seaton (2010) *Cont. to Min. and Pet.* **160**, 591-607.