Growth of clinopyroxenes in a closed system: relationships between T-t paths and zonation

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Zoned minerals provide a record of the changing conditions in magma chamber and as such they can be used to determine the dynamic behaviour of subvolcanic magmatic systems prior to eruption. However, interpreting the record preserved in the crystals requires a detailed understanding of the mechanisms that control zonation in minerals. The purpose of this study is to determine if a correlation can be made between the morphology and composition of zoned crystals and the temperature-time (T-t) paths of their formation. A major goal is to compare the experimentally developed zonation patters, to natural zonation patterns in alkaline basaltic lavas from the Eifel volcanic field in Germany.

Synthetic crystals were grown from a leucititic melt (WEG 1999) in a fO controlled, 1 atm, tube furnace with a Eurotherm

temperature controller. A variety of cooling paths were created with short enough durations, and large enough undercoolings that equilibrium crystal growth (homogeneous crystals), could not occur. In addition to cooling paths, we also performed several experiments with a short heating step to simulate the heating that might take place during an influx of magma. The resulting crystals were imaged with a SEM and high resolution backscattered electron images were collected and processed to highlight growth and zonation patterns. Many of the crystals display hollow cores with feathery crystals indicating that in the first stages of growth the undercooling was high enough to cause quench crystallization. Later growth events produced very complex internal morphologies that are commonly overgrown by a distinctive euhedral rim generated in the final stage of the experiments. The textures produced in the closed system cooling-heating experiments are similar to textures observed in natural volcanic rocks. Further experimentation is required to determine the full range of textures that can be produced, and to determine whether or not this technique can be used to place real time constraints on the cooling and crystallization rates of natural magmas in subvolcanic magma chambers.