Amphibole Reaction Rim Development: EBSD insights into crystal nucleation and growth

Sarah Henton De Angelis[1], Yan Lavallee[1], Jessica Larsen[2], Elisabetta Mariani[1]

[1]University of Liverpool, United Kingdom, [2]University of Alaska Fairbanks, United States

E-mail: pelee83@gmail.com

This study employed electron backscatter diffraction (EBSD) to examine the development of anhydrous reaction rims around magmatic amphiboles. Sample materials from the 2006 eruption of Augustine Volcano, Alaska were utilised. EBSD analysis was performed on 3 sample types: 1) naturally produced amphibole reaction rims; 2) reaction rims produced experimentally by heating; 3) reaction rims produced experimentally by decompression. Amphibole, a hydrous mineral, decomposes to form rims of anhydrous minerals when removed from its thermobarometric stability field. The thickness, texture, and mineralogy of these rims are thought to be reflective of the process driving amphibole disequilibrium (e.g. heating, decompression). However, experimental results show that reaction rim formation is also dependent on the magnitude and duration of amphibole disequilibrium. Further, significant overlap in reaction rim thicknesses and reaction rim microlite textures means that distinguishing between heating and decompression is not simple. EBSD data have demonstrated differences in volcanic plagioclase microlite textures as a function of reaction conditions. We collected crystal orientation maps of amphibole reaction rims to investigate how processes of reaction rim microlite crystal nucleation, rim growth and microlite coarsening vary with changing disequilibrium conditions, magnitudes, and durations. This work aims to show that different disequilibrium conditions result in different crystallisation regimes. Consequently, the results provide further insight into the classification of natural reaction rims on the basis of formation processes.