Geophysical Research Abstracts
Vol. 16, EGU2014-17011, 2014
EGU General Assembly 2014

Thermally-induced amphibole reaction rim development: EBSD insights into microlite orientation

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Amphibole is an important mineral present in many calc-alkaline volcanic deposits. A hydrous phase, volcanic amphibole is only stable at pressures greater than 100 MPa (approx. 4 km), temperature less than ~860-870 oC, and in melts containing at least 4 wt % H_2O. When removed from their thermal and barometric stability field, amphiboles decompose to form aggregate rims of anhydrous minerals. The thickness, texture, and mineralogy of these rims are thought to be reflective of the process driving amphibole disequilibrium (e.g. heating, decompression, etc). However, significant overlap in rim thicknesses and microlite textures means that distinguishing between processes it not simple. This study employed backscatter diffraction (EBSD) to examine both experimental heating-indced amphibole reaction rims and natural amphibole reaction rim from Augustine Volcano. We collected crystal orientation maps of amphibole reaction rims to investigate if different types of disequilibrium produce different patterns of microlite orientation. We identified two types of reaction rim: Type 1- reaction rim microlites are generally oriented at random and share little or no systematic relationship with the crystallographic orientation of the host amphibole, and; Type 2- reaction rim microlites exhibit a topotactic relationship with the host amphibole (they share the same crystallographic orientation). Experimentally produced heating reaction rims are without exception Type 2. However the natural reaction rims are evenly distributed between Types 1 and 2. Further experimental data on decompression induced reaction rim formation is needed to investigate if Type 1 reaction rims resemble the breakdown of amphibole due to decompression. If so, reaction rim microlite orientation could provide a clear method for distinguishing between heating and decompression processes in amphibole bearing magmas.