Identifying transitions in activity and precursors to major eruptive events at Mt. Taranaki, New Zealand

Kimberly Genareau[1], Shane J. Cronin[2], Thomas Platz[3]

[1]Lehigh University, U.S.A., [2]Massey University, New Zealand, [3]Freie Universitat Berlin, Germany

E-mail: kig210@lehigh.edu

Mt. Taranaki, located in the western North Island of New Zealand is an andesite stratovolcano which has been in a state of quiescence for the last >200 years. Its record of >100 eruptions over the last 12,000 years and its upwind position with respect to the largest populated areas of the country means that it presents a significant hazard with any re-awakening. Volcanic activity at Taranaki is characterized by periods of hundreds of years dominated by repeated lava dome growth and collapse, interspersed semi-regularly at 300 year intervals with large sub-Plinian explosive events. In addition to widespread tephra falls, Taranaki has produced hazardous pyroclastic density currents in the form of surges, block-and-ash flows, and column collapse pyroclastic flows that reach run-out distances of up to 15 km from the summit. This study focuses on the sequence of pyroclastic deposits that stratigraphically precede the 1655 AD Burrell Lapilli unit, which was the latest sub-Plinian eruption of Taranaki. This eruption culminated a period of repeated lava effusion and dome growth that lasted roughly 1000 years. The pre-Burrell pyroclastic sequence is comprised of several, fall, flow, and surge units and these tephras were analyzed using a combination of scanning electron microscopy, stereo-scanning electron microscopy, secondary ion mass spectrometry (SIMS), and electron microprobe analyses. SIMS analyses of oscillatory-zoned plagioclase phenocrysts from the Burrell Lapilli show increasing Li contents in crystal rims compared to cores. Profiles across phenocrysts show that Li increases substantially even when An contents increase, decrease, or remain relatively constant, indicating that Li variations reflect properties of the ascending magma parcel rather than local chemical gradients at the melt-crystal interface. In addition, thin (10-20 microns), decompression-induced breakdown rims on amphibole crystals and extensive groundmass crystallization of plagioclase microlites in the indicate changes in the volatile content of the magma leading up to the Burrell explosive phase, and thus, Li trends may allow quantification of the timescale during the final stage of magma ascent prior to the Burrell sub-Plinian explosion. Microtextural and geochemical trends in the pre-Burrell sequence will be compared to those of the subsequent Burrell Lapilli unit to highlight the evolution of magma properties during transitions from effusive to explosive activity. Quantifying physical parameters within conduits and understanding how they vary over time to cause dome collapse events and explosive activity will allow researchers to more accurately model (and ideally, with ongoing analysis of samples collected during an eruption crisis, forecast) volcanic behavior. This will lead to improved hazard assessment strategies for >100 andesitic volcanoes worldwide that show regular variations in effusive and explosive activity like those observed at Taranaki.