A Geochemical and Textural Cross-Section of a Compositionally Zoned Magma Reservoir

JOHN M. ZAYAC[1,2,*], MARC-ANTOINE LONGPRÉ[2,1]

[1]Earth and Environmental Sciences, The Graduate Center, City University of New York, USA (*jzayac@gradcenter.cuny.edu)
[2]School of Earth and Environmental Science, Queens College, City University of New York, USA

Continuous, compositionally zoned eruptions provide a unique opportunity to probe the pre-eruptive distribution of volatiles, chemical species, and phases (melt, crystals, and bubbles) in magmatic systems as they are often interpreted to represent progressive withdrawal from a stratified reservoir. Here we present the results of a fine-scale cross-stratigraphic study of a dacite to andesite zoned eruption from Cosigüina volcano, Nicaragua. From samples collected at 10 cm spacing across the 170-cm-thick pumice–scoria fall deposit, we analyzed the composition of matrix glasses and plagioclase-hosted melt inclusions for major, trace and volatile elements and performed vesicularity and crystallinity measurements. Matrix glasses show near homogeneous microlite-poor, dacitic (67 wt% SiO_2) and microlite-rich, andesitic (58 wt% SiO_2) end-member compositions at either ends of the deposit stratigraphy, separated by a narrow transition zone spanning ~12 % of deposit. Melt inclusion H_2O (~2.5–4 wt%) and CO_2 (<100 ppm) contents exhibit little stratigraphic variation. Concentrations of F (400–800 ppm) and Cl (1000–2000 ppm) decrease by ~50% from dacite to andesite, while S (200–800 ppm) contents abruptly increase. Interestingly, vesicularity shifts from >90% in dacite to ~45% in andesite and correlates more with stratigraphy than composition, which may reflect pre-eruptive exsolved volatile gradients in the magma reservoir. Total crystallinity also trends with stratigraphy from <5% in early dacite to ~ 50% in late andesite, accompanied by a shift in plagioclase phenocryst compositions from An_{40-65} to An_{75-90}.. We interpret these results to suggest that this eruption originated from a continuous, compositionally zoned magma body, that the early erupted dacite was derived from the andesite, and that crystallization-driven volatile exsolution most likely triggered this eruption.