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SPECIAL COLLECTION: PERSPECTIVES ON ORIGINS AND EVOLUTION OF CRUSTAL MAGMAS

Understanding magmatic processes at Telica volcano, Nicaragua: Crystal size distribution and textural analysis

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Abstract

Telica volcano in Nicaragua currently exhibits persistent activity with continuous seismicity and degassing, yet it has not produced lava flows since 1529. To provide insight into magma chamber processes including replenishment and crystallization, crystal size distribution (CSD) profiles of plagioclase feldspar phenocrysts were determined for Quaternary Telica basalts and basaltic andesites. Textural analysis of 14 highly crystalline lavas (>20 vol% phenocrysts) indicates that the samples are dominated by sieve-textured plagioclase feldspar phenocrysts whose origin requires thermochemical disequilibrium within the magmatic system. The CSD curves display an inverse relationship between phenocryst length and population density. Concave-up patterns observed for the Telica lava samples can be represented by linear segments that define two crystal populations: a steeply sloping segment for small crystals (<1.5 mm) and a gently sloping segment for crystals >1.5 mm in length. The two crystal populations may be explained by magma replenishment and a mixing model in which a mafic magma is introduced to a stable chamber that is petrologically and geochemically evolving. Residence times calculated using the defined linear segments of the CSD curves suggest these magmatic processes occur over timescales on the order of decades to centuries. The crystal size distribution and textural analysis advocate for the current persistent activity as being consistent throughout Telica's historic and prehistoric eruptive periods and driven by replenishment of mafic magma.

Keywords: Crystal size distribution, magma mixing, persistent volcanoes, sieve texture, disequilibrium, Telica volcano, plagioclase feldspar