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Amalgamation of plagioclase crystal populations from the magmatic system beneath the volcanic island, Saba

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The volcanic island of Saba, located on the northernmost subaerial end of the active arc of the Lesser Antilles, is a composite stratovolcano. Several andesitic domes, products of Pelean style activity, surround the central peak (Mt. Scenery) and dominate the island, causing its steep slopes. Pumiceous deposits are rare. These uncommon deposits and other extrusive volcanic rocks have common features of mingling textures and enclaves, respectively. These features suggest an interaction between multiple magma pulses shortly before eruption. To unravel the relative history of these pulses, we use plagioclase crystals. Plagioclase is ubiquitous on Saba and is known to record magmatic processes as texturally and chemically distinct zoning patterns.

We studied plagioclase crystals from seven deposits on Saba, including a significant pyroclastic deposit. First, we studied the diversity in crystal textures both within and between volcanic deposits. Analysis of backscatter electron images demonstrate a diversity of crystal textures within single rock samples, including normal, reverse, oscillatory zoning, patchy, sieve, and resorption textures. Then, we conducted crystal size distribution (CSD) analysis using element maps. This analysis shows non-linear distributions confirming that several crystal populations are present in individual rocks. Such populations may be derived from different magma pulses represented by the enclaves or from (partially) solidified host rocks. To find out, we focused on the chemistry of plagioclase. Thus, geochemical analysis of hundreds of crystals and individual zoning were obtained to identify and distinguish these populations. We used Laser-Induced Breakdown Spectroscopy coupled to an Inductively Coupled Plasma Mass Spectrometry (LIBS-ICP-MS) and the combination of multivariate analysis, which allows us to determine the major, minor, and trace elements of individual zoning of crystals simultaneously on the same spot and to understand the mobility and recycling of plagioclase crystals.