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Mafic magma recharge recorded in microlites: evidence from Mt Pelée (Martinique, Lesser Antilles)

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Microlites (crystals $<$100 μm in length) are commonly considered as probes of mechanisms and timescales of magma ascent. However, plagioclase microlites analysed in the andesites from Mt Pelée recent eruptions span a wide range of compositions, from 30 to 90 mol% anorthite (An30 to An90) in dome-forming products and An55 to An90 in plinian pumices. In order to determine the conditions of microlite crystallization, phase equilibrium experiments have been performed on three different starting melt compositions: bulk-rock andesite (AND; SiO2 = 61 wt %), basaltic andesite (BAS; SiO2 = 53 wt %) observed as enclaves in dome-forming products, and rhyolite (RHY; SiO2 = 75 wt %) interstitial glass from the andesite. The determination of the pre-eruptive conditions starting with AND suggests a temperature of 875 $\pm$25°C, a melt H2O content of 6 $\pm$0.5 wt% (aH2O=0.9), and a pressure of 200 $\pm$50 MPa. At this pressure, a maximum composition of An80 is obtained for plagioclase crystallized from AND. To reach An90, crystallization from BAS is required. In the range of pre-eruptive temperatures and for decreasing pressures (200 to 25 MPa), crystallization from RHY gives plagioclase compositions between An55 and $\sim$An30.

Based on these experimental results, it is proposed that the Ca-rich plagioclase microlites (An55-90) form as a result of the recharge of the andesitic reservoir ($\sim$875°C) by hotter mafic magmas ($\sim$950°C). Then, upon ascent in the volcanic conduit, the rhyolitic interstitial melt crystallizes microlites with compositions An30-55, provided magma ascent is slow enough. This accounts for the whole range of microlite compositions observed in the dome-forming products. In plinian pumices, the fast ascent does not allow microlite crystallization in the volcanic conduit. In these samples, microlites

(An55-90) only correspond to crystals formed during the magma mixing event in the reservoir. In the absence of medium-scale heterogeneities (mafic enclaves or banded rocks), the study of microlites provides here a microscopic-scale window (1-100 μm) into mafic-silicic magma interaction processes.