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Crystallization conditions showed by the resurgent dome in the 900 years BP eruption of Cerro Machín Volcano, Colombia

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Volcán Cerro Machín (VCM), a composite volcano located in the Colombian Central Cordillera, is considered to be among the potentially most explosive volcanoes of Colombia, due to its dacitic magma composition and the magnitude of past eruptions. For the past 5000 years, six major eruptions have been described, four plinian and two vulcanian/peléan eruptions. To give an assessment of volcanic hazards in the case of future eruptions, it is essential to understand past eruptions and the dynamics of a given magmatic system. The youngest major eruption, dated at 900 years BP, generated a late-stage lava dome which was investigated mineralogically and geochemically in order to unravel pre-eruptive processes. The partly glassy to fully crystallised dacitic rocks (65.3 – 66.2 wt.% SiO_2) contain plagioclase (An_{24-54}), amphibole (tschermakite to magnesiohastingsite), quartz, mica, ilmenite and olivine (Fo_{85-88}). Most plagioclase crystals exhibit complex oscillatory zonation patterns, interpreted to reflect repeated replenishment and fractionation cycles in the magma chamber. The common occurrence of partly resorbed and strongly reversely zoned plagioclase (core: An_{30-40}, rim: An_{49-54}), reversely zoned amphibole (core: Mg# 0.66 – 0.69, Al_2O_3contents with 11.8 wt.%, rim: Mg# 0.69 – 0.89, Al_2O_3content with 12.8 wt.%), magnesian olivine with well developed amphibole reaction rims, and of resorbed quartz, is taken as evidence for mixing between a felsic and a basaltic magma. Amphibole thermobarometry gives equilibration conditions of 250 – 475 MPa and 865 – 940 ˚C for most amphiboles, except for the reversely zoned rims, which reflect an isobaric temperature increase of about 100 ˚C (925 – 1000 ˚C). The high temperatures are interpreted as strong evidence for replenishment of basaltic magma into the crustal reservoir with resident felsic magma, probably enabling the late-stage dome eruption. The calculated crystallization depths of 9 to 18 km could be related to seismic activity observed in 12 to 18 km depth. Assuming fluid oversaturation of the dacitic magmas, the crystallization depths would correspond to original water contents in the magmas of about 5 to 8 wt. %.