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Shifting eruption dynamics: Constraints from mineral chemistry and plagioclase-hosted melt inclusions at Santiaguito volcanic dome complex, Guatemala

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Activity at Santiaguito volcanic dome complex started in 1922 with the continuous eruption of crystal-rich dacitic-andesitic lavas, which over the course of the last century, constructed a series of four domes and were host to frequent minor explosions. In 2016, a drastic shift in activity occurred with an 8-months period of heightened explosion intensity. We present records of textural and compositional variations in plagioclase, orthopyroxene and plagioclase-hosted melt inclusions of a series of ash and ballistic samples erupted and collected in-situ between 2015 and 2019 to reconstruct the magmatic processes associated with such shifts in activity.

Plagioclase phenocrysts show a wide range of compositions (An_{90-35}) and can be grouped into three populations based on compositional and textural variations: crystals with resorbed albite-rich cores (An_{35-40}), anorthite-rich cores (An_{85-90}) and patchy zoned cores (An_{50-85}). All plagioclase crystals contain homogenous rims of An_{50} that are marked by an increase in Fe content from about 3000 to 5000 ppm and a higher Mg content (of up to 300 ppm) towards the rim. Orthopyroxene phenocrysts show constant enstatite compositions from core to rim (En_{68-70}). However, rims are relatively enriched and depleted in Ti and Mn contents respectively. Plagioclase-hosted melt inclusions are found in reversely zoned crystals, in crystal rims and between glomerocrysts. Irregularly shaped melt pockets are frequently observed in patchy zoned cores. Melt inclusions overall range in silica content from 71 to 78 SiO_2 wt.% (anhydrous) and are marked by relatively high TiO_2 and K_2O contents.

Melt and mineral compositions and textures suggest that a shallow magma storage zone currently exists below Santiaguito volcanic dome complex. Pressure estimates of plagioclase-hosted melt inclusions yield an average of about 150 MPa (\pm 50 MPa) using rhyolite-MELTS indicating magma storage at depth of about 4 to 8 km. The observed increase in Fe, Mg and Ti contents in the rims of the plagioclase and orthopyroxene phenocrysts and microlite crystals are consistent with recharge of new magma into the upper crust, which was likely responsible for the drastic shift in eruption dynamics at Santiaguito volcanic dome complex in 2015-2016.