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Pre-eruptive magmatic processes associated with the historical (218 ± 14 aBP) explosive eruption of Tutupaca

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Understanding the triggering mechanism associated with eruption of silica-rich magmas is a key step for volcanic hazard assessment. Tutupaca volcano (Southern Peru) explosively erupted at 218 ± 14 aBP, producing a debris avalanche and a sequence of pyroclastic density currents, whose deposits are widespread distributed to the NE of the volcano (see Samaniego et al. this meeting). The erupted products are homogeneous dacites (63.2-68.0 wt.% SiO2) bearing a mineral assemblage composed of plagioclase, hornblende, biotite, clinopyroxene and Fe-Ti oxides together with some accessory minerals such as sphene, apatite and quartz. Based on thermo-barometric analyses, the temperature and pressure of the dacite magmas is estimated at 735 ± 23° C and 180-300 MPa (corresponding to a depth range between 7 and 10 km); and a water content of at least at least 4-6 wt.%. Detailed mineralogical studies show frequent disequilibrium textures (reverse zonation associated with resorption and overgrowth rims) in plagioclase and amphibole phenocrysts. These disequilibrium textures point out for a heating process by intrusion of a primitive magma in the dacitic magma chamber. This hypothesis is supported by the presence of rare mafic enclaves (53-58 wt.% SiO2), found in the dacite domes, which provided a higher temperature estimate (835 ± 41 °C). Thus, the most recent eruption of Tutupaca was triggered by a self-mixing process at a highly crystallized dacitic magma body that was reheated and remobilized by the intrusion of a much hotter, primitive magma. This process triggered the destabilization of the edifice, producing the debris avalanche and the associated pyroclastic eruption.