Recharge, recycle, repeat: The steady-state plumbing system of Popocatépetl volcano, Mexico

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Popocatépetl (Popo) is a quaternary stratovolcano located about 70 km SE of Mexico City. Continuously active since 1994, the present-day edifice is shaped by voluminous lava flows punctuated by at least six Plinian eruptions in the last 23 ka, the largest one being the VEI 6 Tutti Frutti Plinian eruption ~14 ka BP.

We present a detailed textural and compositional study of phenocryst assemblages and populations in effusive and explosive products of the last 14 ka. Both pumices and lavas are hybridised products of 1) a mafic magma with a phenocryst assemblage of Cr-spl + ol ($\leq Fo_{88}$) + opx (Mg# 79–90) + cpx (Mg# 84–93) ± pl at T=1040–1070°C, and 2) an evolved magma with T<960°C and pl (An_{32-50}) + opx (Mg# 53–71) + cpx (Mg# 67–77) + ap + ox. Compositionally zoned px and pl and varying degrees of diffusive overprints imply frequent mafic injections into the evolved magma. Fe-Mg diffusion modelling in opx reveals pre-eruptive crystal residence times in the evolved melt from >1000 years to <7 days. This suggests that the evolved reservoir comprises multiple generations of antecrysts, and that mafic recharge can rapidly trigger both explosive and effusive eruptions by remobilising and recycling this reservoir. Pumices and lavas of the last 14 ka show consistent crystal populations only varying in modal abundances, and homogeneous whole-rock compositions. We therefore argue that Popo is buffered by an integrative, compositionally stable, steady-state plumbing system since at least the Tutti Frutti Plinian eruption 14 ka BP.